

**VOCABULARY INTERVENTION AIMED AT IMPROVING EXPRESSIVE LANGUAGE  
FOR CHILDREN WITH HEARING IMPAIRMENT**

**by**

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### **Abstract**

Children with hearing impairment are at risk of language delay. Language delays can have far reaching consequences. Language delay in children with hearing impairment is thought to be due to receiving insufficient auditory information during the critical period. This study investigated whether a hybrid language intervention program could be used with children with hearing impairment to improve their language delay. Three participants, two participants who wore hearing aids, and one participant who had a cochlear implant, participated in an intervention programme targeting vocabulary. All participants had unique patterns of hearing loss and all had a language delay. There were three phases to this study. An assessment and baseline testing phase, an intervention phase and a post-intervention phase. Outcome measures were: number of target verbs produced, Mean Length of Utterance (MLU) in morphemes, and the number of different words in a conversational language sample. Results indicated all three participants improved in their production of the target verbs. Contrary to expectations, an increase in MLU in morphemes did not occur. Only one participant had a significant increase in the number of different words. These findings suggest children with hearing impairment and language delay are stimuable to intervention. Further research is warranted into whether the hybrid intervention program used in this study may be more applicable to children of younger ages with hearing impairment.

## **Introduction**

The worldwide newborn hearing screening programs are decreasing the age at which hearing loss, especially profound hearing loss is detected (Geers, 2004). However, within New Zealand newborn hearing screening is not national nor yet commonplace. At present, there are three regions participating in the newborn hearing screening program in New Zealand (National Screening Unit, nd). It is intended that another nine District Health Boards will roll out the program over 2008/2009 (National Screening Unit, nd).

Because the newborn hearing screening program is not yet nationwide, children with hearing loss are often detected and diagnosed at later ages. On average, children with hearing loss in New Zealand are not identified until four years of age (National Screening Unit, nd). This means that some children who are candidates for cochlear implants are being implanted at older ages and after the ideal implantation age of six to twenty-four months (Nicholas & Geers, 2007). Children who are implanted after the age of two years have been shown to exhibit language delays in comparison to their age-matched peers (Nicholas & Geers, 2007). Children who are fitted with hearing aids with a similar degree of hearing loss to that of children with cochlear implants have been shown to be even more delayed when it comes to speech and language development (Meyer, Svirskey, Kirk & Miyamoto, 1998). A language delay is defined as an impairment in the development of language content, form or use, where the child is at a stage of development lower than expected for their chronological age (Fey, 1986).

The critical period is a period of time from birth to three years where the brain is particularly sensitive to learning auditory information (McDonald-Connor, Craig, Raudenbush, Heavner & Zwolan, 2006). The critical period lays the foundations for speech and language development (McDonald-Connor et al., 2006). Language delays seen in children with hearing impairment have been suggested to be due to the limited opportunity to obtain auditory information during the critical period (Nicholas & Geers, 2007). Because the average age of diagnosis of a hearing loss is currently four years in New Zealand, these children with hearing loss are missing out on the critical period and developing language delays. This paper investigates whether a hybrid language intervention



program previously used with significant success on a child with cleft palate and language delay can also be applied to children with hearing impairment and language delay (Page & Moran, 2007).

### Hearing Aids and Cochlear Implants

Before the advent of hearing aids and then later, cochlear implants, children who had a severe to profound hearing loss had limited means of developing oral communication (Cole & Flexer, 2007). Sign language was the main form of communication. Developments in technology have provided children with an increased opportunity to develop oral language (Cole & Flexer, 2007).

When an infant or child is initially diagnosed with hearing loss, the first intervention actioned will usually consist of fitting hearing aids (Gabbard & Schryer, 2003). Hearing aids amplify the acoustic signal to enable the infant or young child to hear important speech and environmental sounds (Cole & Flexer, 2007). For children, the most common style of hearing aid is behind-the-ear (BTE) (Cole & Flexer, 2007). The BTE is typically coupled to the ear via an earmould. This style of hearing aid is preferred for infants and young children because it is generally more robust, enables the coupling of other assistive listening devices, can accommodate the infant or young child's rapidly growing ear, and can be easily attached to the child's clothing to prevent the hearing aid being lost (Gabbard & Schryer, 2003). The additional advantage of hearing aids is that they can be fitted at any age while cochlear implants are generally not implanted before six months of age (Cole & Flexer, 2007). When fitting hearing aids to an infant, the audiologist needs to particularly consider levels of amplification at the high frequencies as these high frequencies contain important consonants that help with the intelligibility of speech (Cole & Flexer, 2007). However, the low frequencies should not be under-estimated. The lower frequencies are where vowels and suprasegmentals of speech are located (Cole & Flexer, 2007).

Hearing aids are not the only solution for infants and children with hearing impairment. Hearing aids do have some disadvantages, including difficulty in fitting and retaining the hearing aid (because of small ear and ear canal size), and increased opportunities for acoustic feedback to occur when the infant lies down or is held close to someone (Cole & Flexer, 2007). Background noise is often a real issue for all hearing aid wearers but especially for infants and young children (Cole &

Flexer, 2007). While the hearing aid enables the speech signal to be heard clearly in quiet, background noise acts to mask out the speech signal, often meaning that the hearing aid is just amplifying the noise (Cole & Flexer, 2007). Background noise is a particular problem as the infant or young child is unable to tell an adult that they cannot hear the speech signal clearly. Management of background noise can be achieved through use of a Frequency Modulated system (FM) (Cole & Flexer, 2007). This is a transmitter that the speaker uses, speech signals are sent via radio waves to a radio (FM) receiver that is connected to the hearing aid or cochlear implant (Cole & Flexer, 2007). The person wearing the FM receiver gets the speech message delivered directly to the ear and background noise is minimised (Cole & Flexer, 2007).

An alternative to hearing aids for a child with a severe to profound hearing loss is a cochlear implant. Cochlear implants use electrical stimulation instead of acoustical stimulation employed by hearing aids (Estabrooks, 1998). Cochlear implants were approved for use in children by the FDA (Food and Drug Administration) in the United States in 1990 (Estabrooks, 1998). A cochlear implant is a device that by-passes the outer and middle ear and directly stimulates the auditory nerve with electrical pulses through the cochlea (Estabrooks, 1998). A cochlear implant has several components. These are the implant itself and the speech processor. The implant consists of an array of electrodes with a receiver and magnet to enable external coupling to the speech processor (Estabrooks, 1998). The speech processor consists of a microphone, transmitter and processing strategies (Estabrooks, 1998).

The role of the speech processor in a cochlear implant is to take in the incoming acoustic signal from the environment, process it using a speech processing strategy and then send this processed signal to the implant which uses electrical pulses to stimulate the cochlea (Estabrooks, 1998). This information is then transmitted to the brain via the auditory nerve (Estabrooks, 1998). Once a child is implanted they are provided with intensive habilitation to get them accustomed to sounds in their environment and to enable them to begin to learn speech and language (Estabrooks, 1998).

The current main processing strategy for cochlear implants presently used for New Zealand children is ACE (Advanced Combination Encoder) and has been shown to provide highly satisfactory levels of speech perception in quiet environments (Wilson, 2006). ACE uses up to 22 channels for

stimulation (Skinner, Arndt & Staller, 2002). Two of the main features of ACE are non-simultaneous stimulation and the use of high cut-off frequencies for the envelope detectors (Wilson, 2006). ACE employs the use of  $n$  and  $m$  (Wilson, 2006).  $N$  represents the channels used and spans from 6 to 16 (Wilson, 2006).  $M$  represents the electrodes and spans from 20 to 22 (Wilson, 2006).  $N$  channels are selected in ACE by scanning the channel outputs. Only the channels with the highest envelope signals are picked out before stimulation occurs across the electrodes (Wilson, 2006). Only a selection of  $m$  electrodes have stimulus pulses conveyed to them and this corresponds to the number of  $n$  channels selected (Wilson, 2006). The idea of selecting the highest envelope signals intends to decrease the mass of stimulation while continuing to portray the most vital characteristics of the acoustic environment (Wilson, 2006). ACE uses a frequency distribution that is linear until approximately 1300Hz and a logarithmic distribution after 1300Hz until the maximum frequency (Wilson, 2006). This frequency distribution intends to mimic the scale of normal hearing (Wilson, 2006).

Current selection criteria for children and infants for cochlear implantation includes the following (Bradham & Jones, 2008):

1. A moderate to profound bilateral sensorineural hearing loss.
2. Able to obtain little benefit from conventional hearing aids that are fitted appropriately to the child's hearing loss. The child must have trialed hearing aids before consideration for cochlear implantation is made.
3. The auditory nerve must be functional for stimulation. This is because the auditory nerve connects the cochlea to the brain to enable transmission of auditory information.
4. The child will be making little improvement in terms of auditory development.
5. The family or child's caregivers must be willing for the child to be primarily brought up in an auditory/oral environment and have a high level of motivation and commitment to habilitation sessions after implantation.
6. The child must be healthy for surgery and have no medical contraindications such as ongoing middle ear dysfunction.

### Critical Period and Language Development

The use of hearing aids and cochlear implants for young children with hearing impairment can help to assist them to hear auditory information during the critical period. The critical period refers to a time when the brain is particularly plastic for learning new information early in life (McDonald-Connor et al., 2006). It is suggested that from birth to approximately three years of age the central auditory system and brain are particularly sensitive to speech sounds (McDonald-Connor et al. 2006). New neural connections are constantly being generated and these help to lay the foundations for learning to talk (McDonald-Connor et al. 2006; Sharma, Dorman & Spahr, 2002). It is thought that children who are profoundly deaf and who are fitted with hearing aids or cochlear implants at a later age miss out on the critical period of language learning (Carney & Moeller, 1998; Nicholas & Geers, 2007; Sharma et al., 2002). It has been stated that a lack of auditory stimulation from a young age can result in neurological alterations within the brain (McDonald-Connor et al., 2006). Other electrophysiological studies using evoked potentials support this theory (Neville, Mills & Lawson, 1992; Sharma et al., 2002). Areas of the brain that are designed to be devoted to auditory pathways are taken over by other sensory pathways, such as vision, that may be more highly utilized in a child that is hard of hearing (McDonald-Connor et al., 2006; Nicholas & Geers, 2007). Sharma et al. (2002) investigated the P1 response (electrophysical measure) in children who varied in which the age that they received their cochlear implant. They found that children implanted after the age of seven years exhibited degenerative effects in the central auditory system and plasticity was largely reduced (Sharma et al., 2002). This additionally provides anatomical evidence for the critical period from birth to approximately three years of age (Sharma et al., 2002). When a child is eventually provided with amplification they need to re-connect and develop the pathways that are designed for auditory information when the brain is less plastic, hence this may be one of the reasons why language development is slower (Nicholas & Geers, 2007).

The theory of a critical period for children with hearing impairment has been expanded by Tomblin, Barker, Spencer, Zhang & Gantz (2005). During the critical period, children experience a large language burst that provides the foundations for further language development. Tomblin et al. (2005) showed that children implanted after two years of age with cochlear implants did not experience this 'language burst' and hence were slower in speech and language development. In

comparison, Nicholas and Geers (2007) found that children who obtained their cochlear implant by two years of age achieved speech and language skills that were comparable to their age-matched peers. These early implanted children were also more likely to enter mainstream schooling (Nicholas & Geers, 2007). These results show that if a child is implanted by two years of age they are able to access sound information during the critical period and do not experience language delay. Similarly, Hammes et al. (2002) investigated the ages that children were implanted and whether they obtained appropriate speech and language skills in relation to their hearing-age peers. Results indicated that 70% of children who were implanted by 18 months had speech and language skills that were to a maximum of one year behind of what is considered typical speech and language development (Hammes et al. 2002). However, less than 5% of children implanted between 41 and 48 months obtained speech and language skills appropriate to their chronological age (Hammes et al. 2002). Hence it seems that early diagnosis is critical.

The importance of amplification during the critical period is reinforced by Yoshinaga-Itano and Apuzzo (1998) who compared the language abilities at age 40 months for four groups of children. The children differed by the age when their hearing loss was identified; the four age groups were: birth to 2 months, 3 to 12 months, 13 to 18 months and 19 to 25 months. Each group had hearing losses ranging from mild to profound and early intervention was provided to each child soon after the hearing loss was identified (Yoshinaga-Itano & Apuzzo, 1998). The researchers found that although each group had received very similar intervention services, the first group (aged birth to 2 months) had superior language skills when compared to the other groups (Yoshinaga-Itano & Apuzzo, 1998).

Children who have been fitted with hearing aids rather than cochlear implants with similar levels of hearing loss also demonstrate delayed language that persists into adulthood (Tye-Murray, 2004). Meyer et al. (1998) compared aspects of speech and language development between children with cochlear implants and children with hearing aids with similar hearing losses. Although both groups tended to be delayed in comparison to normal hearing children, children with hearing aids did not make the same achievement gains in development as children with cochlear implants (Meyer et al., 1998). This may indicate that during the critical period, children fitted with hearing aids do not receive the same quality of auditory information as those children with cochlear implants.

### Language Delay in Children with Hearing Impairment

A child needs a language base from which to begin to communicate with the world (Yoshinaga-Itano, 2003). To be able to engage in conversation or respond to communication, a child needs to understand first what is being spoken (Yoshinaga-Itano, 2003). From this basis alone one could argue that the appropriate development of language skills is far more important than speech development, at least in the first few years of life.

The inability to develop appropriate oral language can affect the ability to learn to read, communicate effectively with others, influence comprehension in situations such as the school classroom, affect the child's self esteem and socialisation skills, and generally influence overall academic achievement and outcome (Moeller, 2000). Previous studies of deaf children that communicate primarily through oral means show that these children often have difficulty integrating socially within the school environment (Bat-Chava, Martin & Kosciw, 2005). Bat-Chava et al. (2005) compared the socialisation abilities of children using hearing aids or cochlear implants. Results indicated that children who used cochlear implants were able to develop better socialisation skills as a result of improved communication abilities in comparison to children using hearing aids with similar levels of hearing loss (Bat-Chava et al., 2005). Remediation of a language delay could potentially prevent future socialisation difficulties.

Language delay can affect both children with hearing aids and children with cochlear implants. Children who use cochlear implants have been stated to have better language and vocabulary development when compared to children who use hearing aids (Geers & Moog, 1994). Children who wear hearing aids and have a significant hearing loss can have difficulty in all areas of language such as pragmatics, syntax and more importantly, vocabulary (Tye-Murray, 2004). However, it has been well established that children implanted with cochlear implants after 24 months will be more likely to have language development that is significantly poorer than their normal hearing peers (Geers, 2004; Nicholas & Geers, 2007).

When looking at studies of language development in children with cochlear implants, age at implantation, duration of implant use, the amount of pre-implant residual hearing, type of cochlear

implant technology and speech processing strategy all need to be considered as these can affect language development (Nicholas & Geers, 2007). For example, a child using the ACE (Advanced Combination Encoder) speech processing strategy may have better access to auditory information than a child using the older SPEAK (Spectral Peak Extraction) strategy (Geers, 2004). Nicholas and Geers's (2007) investigated language development in children with cochlear implants. They found the age at which a child was implanted had a significant effect on language development when compared to duration of implant use (Nicholas & Geers, 2007). Even when duration of implant use was controlled for, children that were implanted by 18 months had language scores superior to children implanted at older ages (Nicholas & Geers, 2007). It has been stated that age of implantation can be the single most important predictor of language development in children with cochlear implants as the age at when they were implanted can impact upon the critical period (Sharma et al., 2002). Studies have shown that age of implantation can directly effect vocabulary development in children with cochlear implants (Bollard, Chute, Popp & Parisier, 1999; Connor, Heiber, Arts & Zwolan, 2000). Bollard et al. (1999) found children who were implanted at a younger age achieved larger vocabulary growth rates after 18 months of device use. As with all studies of childhood development, these studies note that there is wide variation amongst cochlear implant recipients and in respect to their progress in development and outcomes (Geers, 2004).

Although age of implantation is important, other factors such as the degree of residual hearing pre-implant can affect outcomes. Children that have a greater degree of pre-surgery residual hearing have been shown to perform better in post-implant speech and language measures (Nicholas & Geers, 2007). This may be due to the amount of auditory exposure they received before implantation as they would have been able to benefit more from the use of hearing aids (Nicholas & Geers, 2007). These children with more pre-residual hearing can be implanted at later ages with more success as their exposure to audition may act as the link for language development (Nicholas & Geers, 2007). It has been stated that children with more residual hearing have better spoken language outcomes irrespective of age of implantation (Nicholas & Geers, 2007).

There are many other factors that can interact and impact the success of cochlear implantation for a hearing impaired child. There is relatively little literature about whether children implanted at later ages ever catch up to their hearing peers in terms of language development. Some studies report that

school children implanted by five years of age with a cochlear implant can make large gains in language development to such an extent that they can become age-equivalent to their hearing peers (Nicholas & Geers, 2007). However, these children continue to exhibit delays in regards to academic success and verbal intelligence quota (Nicholas & Geers, 2007). Another study stated that the time for the auditory pathways (measured by monitoring of the P1 response) to reach maturity in late implanted children with cochlear implants is equalled to the duration of deafness that they experienced (Eggermont, Ponton, Don, Waring & Kwong, 1997). Geers (2004) completed a study on children aged eight to nine years of age who had received a cochlear implant between the ages of 24 and 35 months. These children were examined on their speech and language skills in comparison to their normal hearing age peers. Geers noted that only 43% had age-equivalent speech and language skills (Geers, 2004). Children implanted at later ages may also have increased difficulty beginning kindergarten and transitioning into mainstream schooling (Nicholas & Geers, 2007).

Evidence indicates that children with hearing impairment and children who are implanted at later ages with cochlear implants will be at risk of language delay (Nicholas & Geers, 2007). Language delay in children with hearing impairment is characterised by poor syntactic development and a restricted vocabulary (Tye-Murray, 2004). Blamey et al. (2001) conducted a study looking at the development of language, speech production and speech perception in a group of 87 children with a cochlear implant or hearing aids with severe to profound hearing losses. They concluded that hearing impairment impacts and delays vocabulary development (Blamey et al., 2001). The use of vocabulary is vital to linguistic development. Fischel, Whitehurst, Caulfield and De Baryshe (1989) stated that a delay in expressive vocabulary can mean that the child is at risk of having difficulty in other areas of language development. They also stated that a child presenting with an expressive delay at two years of age did not self-correct this delay, at least before entry to formal schooling (Fischel et al., 1989). A child who is profoundly deaf will have an average vocabulary of approximately 250 words by five years of age (Kirk & Hill-Brown, 1985). In comparison, the average normal hearing child will have approximately 2,000 to 26,000 words (Kirk & Hill-Brown, 1985). Syntax can also be affected in children with hearing impairment. Function words may be omitted and sentences produced will be telegraphic (Tye-Murray, 2004). Sentence structure may never move past the basic subject-verb-object form in comparison to children with normal hearing (Tye-Murray, 2004).



Vocabulary affects grammatical development and a close relationship has been established between the two (Goodman & Bates, 1997). In order to produce a sentence, the child must have the words needed for that sentence in their vocabulary. When a child is beginning to put words together to form early sentences, verbs are used to precede nouns in order to request an action or object, for example “*want bottle*”. Verbs are also needed in order for the child to develop more adult language structures as verbs are used to create sentences of meaning (Hadley, 1998). Both syntactic (arrangement of words in sentences) and semantic (meaning of word or phrase) development is assisted or affected by verb meaning and its development (Hadley, 1998). Hadley (1998) investigated grammatical development in young children with specific language impairment (SLI). Hadley identified that these children had a specific area of weakness in verb-phrase elaboration and proposed that verb-phrase elaboration appeared to be linked to the size and depth of the child’s verb vocabulary earlier on in development (Hadley, 1998). Thereby by focusing on verbs, later verb-phrase elaboration will be improved. This is supported by previous studies. Watkins, Rice and Moltz (1993) stated that children with SLI appear to have a concentrated difficulty in both learning and using verbs in receptive and expressive language.

There is research to suggest that for children with normal hearing, the first year of life is especially critical for vocabulary development (McDonald-Connor et al., 2006). Children who are hearing impaired, especially ones that receive a cochlear implant at a later age, will miss out on this early opportunity for learning vocabulary (McDonald-Connor et al., 2006). Children with normal hearing in the first year of life have been shown to make more vocabulary gains if their parents increase the frequency of communication with their infants (McDonald-Connor et al., 2006). During this time children will begin to exhibit joint attention and referencing (McLeod & Bleile, 2003). They use pointing to request an action and have basic speech acts such as greeting, opposing and referencing (McLeod & Bleile, 2003). It is also thought this early opportunity for learning vocabulary provides the groundwork which affects the speed at which children learn vocabulary at later ages (McDonald-Connor et al., 2006). Towards the end of the critical period at age three years a normal developing child will have an Mean Length of Utterance (MLU) of between 2.0 to 3.0 (McLeod & Bleile, 2003). MLU is a calculation that is made from a language sample where the child’s average utterance length is obtained and compared to norms (Eisenberg, McGovern Fersko, & Lundgren, 2001). They will be beginning to use plurals, form bigger sentences and start to use question forms

(McLeod & Bleile, 2003). McDonald-Connor et al. (2006) examined the age at which a child received their cochlear implant. They found that children who were implanted at early ages had vocabulary scores that were better than children using hearing aids at any age (McDonald-Connor et al., 2006). This difference may be because the amount of auditory information supplied through a cochlear implant may be greater when compared to a hearing aid (McKinley & Warren, 2000). It may also be the fact that cochlear implants convey more high frequency information which is more important in recognising key consonants in speech (McKinley & Warren, 2000).

A child's vocabulary development can impact their ability to learn to read. Literature indicates that children who have hearing impairment or are implanted at an older age are also at risk for developing a reading delay, particularly those with a severe to profound hearing loss (McDonald-Connor & Zwolan, 2004). This is because in order to read, a person first needs to have knowledge of the lexical and linguistic structure of words. If a child has a strong language base they will have a better foundation on which to learn to read (McDonald-Connor & Zwolan, 2004). Hearing loss will slow vocabulary growth (Blamey et al. 2001). In turn, vocabulary level for a child with a cochlear implant or hearing aids has been shown to be directly related to reading outcomes (McDonald-Connor & Zwolan, 2004; Tye-Murray, 2004). Research has shown that delays in vocabulary can be used to predict later language development and success in learning to read (Girolametto, Wiigs, Smyth, Weitzman & Pearce, 2001). Girolametto et al., (2001) looked at the outcomes of five year-old children who had been identified at two to three years of age as being late talkers, i.e. their vocabulary development was delayed in comparison to normalised samples. Their findings suggested that although the children had caught up in some areas, linguistic tasks that required higher levels of language were still delayed, particularly narrative performance (Girolametto et al., 2001). Girolametto et al. (2001) recommended that children identified with language delay be monitored periodically throughout preschool and the early school years to ensure that the early difficulties they experienced did not transition when learning to read. At age five years a child should have an MLU of between 4.0 to 6.8 (Brown, 1973).

When a child has a potential language delay, the degree and complexity of their delay needs to be established. Vocabulary development is one way the child's communication skills can be measured (McDonald-Connor et al., 2006). This can be achieved by examining Mean Length of Utterance

(MLU) (Eisenberg et al., 2001). However, Eisenberg et al. (2001) stated that it is important to remember that MLU should not be interpreted as a gauge for syntactic development. It should be considered in a range of tests used as evidence of a language impairment (Eisenberg et al., 2001). When using MLU, the sample size should never be smaller than 50 utterances in order to be reflective of the child's true expressive ability (Eisenberg et al., 2001). A low MLU taken from a detailed analysis of a language sample can indicate language delay in the preschool years (Eisenberg et al., 2001). For example, Paul (2001) has stated that if a child has an MLU lower than three, it may be appropriate for intervention to focus on semantic relations. By concentrating on semantic relations, basic Subject-Verb-Object sentences can be developed with the eventual progress to multi-word utterances (Brown, 1973). Devescovi et al. (2005) looked at the relationship between grammar and lexicon in a group of English and Italian speaking children. These researchers found that vocabulary size contributed to the size of the child's MLU and that vocabulary was a good basis from which to compare grammatical progress (Devescovi et al., 2005). They stated that vocabulary was one way in which the child's MLU could be predicted (Devescovi et al., 2005).

**Table 1.** *Expected MLU in morphemes for children with typically developing language (McLeod & Bleile, 2003).*

Age	MLU
12 – 26 Months	1.0 – 2.0
27 – 30 Months	2.0 – 2.5
31 – 34 Months	2.5 – 3.0
35 – 40 Months	3.0 – 3.75
41 – 46 Months	3.75 – 4.5

### Intervention for Children with Hearing Impairment

It is widely recognised that the best habilitation for a child with hearing loss is early identification and early intervention (Carney & Moeller, 1998). Early identification of the hearing impairment alone is not sufficient to prevent language delay; early intervention must be provided also (Yoshinaga-Itano, Sedey, Coulter & Mehl, 1998). Intervention is more than the fitting of amplification, it includes the monitoring of the child's speech and language, overall development and assisting before delays occur (Yoshinaga-Itano et al., 1998). Children with hearing impairment who are identified and provided with early intervention by six months of age develop language skills similar to that of their normal hearing peers (Yoshinaga-Itano et al., 1998). These children are in the lower catchment for what is considered normal, but this is a vast contrast to children identified after six months of age (Yoshinaga-Itano et al., 1998). By providing early intervention such as Auditory Verbal Therapy, the child is more accepting of their hearing aid or cochlear implant and this helps prevent 'non-use' (Meyer et al., 1998). However, in a country like New Zealand where newborn hearing screening is not yet national, the six month target age is not often accomplished and diagnosis can be not until four years of age (National Screening Unit, nd).

There are many studies documenting the ages at which children with a hearing loss are identified and subsequently when early intervention begins. One study showing evidence of early identification and intervention was Yoshinaga-Itano and Apuzzo (1998). This study looked at the language capabilities of a group of 109 children with a mean hearing impairment of moderate to severe; 46 of whom were identified before six months, and 63 after six months. Children who participated in this study had all enrolled in CHIP (Colorado Home Intervention Program). This is an intervention program provided in the family home (Yoshinaga-Itano et al., 1998). A therapist teaches the parent to be the primary facilitator with techniques to foster the child's listening ability and speech and language development (Yoshinaga-Itano et al., 1998). The children were assessed on language measures between the ages of 13 and 18 months. There was little difference in the language abilities between the two groups; the earlier identified group had a slight advantage but this was not statistically significant. The two groups were assessed again on language measures at age thirty-one to thirty-six months. This time the group that was identified later had a ten-month language delay compared to the early identified group (Yoshinaga-Itano & Apuzzo, 1998). This

result also lends support to the critical period theory. The children that were identified early were provided with amplification to enable them to learn and hear language when their brains were most sensitive to that stimuli (Yoshinaga-Itano & Apuzzo, 1998).

Moeller (2000) found that vocabulary abilities were significantly better if the child with hearing impairment was enrolled in early intervention. Of note however, is that it is relatively unknown whether these advantages seen in the early-identified children are maintained as they age (Moeller, 2000). Moeller (2000) investigated the age of enrolment in early intervention and how this impacted on the child's vocabulary and overall language development. She found that if the child was provided with early intervention before 11 months of age, their vocabulary and overall verbal reasoning skills were significantly better at five years of age compared to children provided with early intervention at later ages and had vocabulary scores similar to their normal hearing-age peers (Moeller, 2000). Moeller also found that if a child was provided with intervention after the age of 24 months, then their vocabulary scores were 1.0 to 1.5 standard deviations below the mean in comparison to normal hearing peers (Moeller, 2000). Blamey et al. (2001) found that if a child with hearing impairment did not receive sufficient and effective early intervention, they would begin secondary school at 12 years with a language delay of four to five years (Blamey et al., 2001).

Auditory Verbal Therapy (AVT) is one habilitation approach that is commonly considered for young children with cochlear implants or hearing aids. The focus of Auditory Verbal Therapy is predominantly speech and speech perception (Estabrooks, 1994). Auditory Verbal Therapy is best suited to children that have been provided with amplification from a young age, have no additional disabilities and whose parents wish for the child to develop spoken language (Estabrooks, 1994). For children with other disabilities, a combination of approaches for habilitation may be better, such as some elements of Auditory Verbal Therapy, combined with the use of key signs (Estabrooks, 1994). Auditory Verbal Therapy is based on trying to provide the child with the tools to develop appropriate listening behaviours and speech (Estabrook, 1994). Receptive language is not targeted to the same extent. There are four areas that are specifically targeted. These are regularly checking the child's hearing aid or cochlear implant for problems, ensuring that the child wears the cochlear implant/hearing aid from when they wake up to when they go to bed, using speech that is well-

articulated and intelligible when communicating, and reducing any background noise as background noise may interfere with the speech signal that the child is listening to (Estabrooks, 1994).

For a child with a hearing impairment that has both a receptive and expressive language delay with a particular deficit in vocabulary, Auditory Verbal Therapy may not be the best approach. Research suggests it is often more effective to use a variety of the typical therapy formats when focusing specifically on improving vocabulary (Bryant, Goodwin, Bryant & Higgins, 2003). Such formats for therapy include clinician-directed, child-directed, and hybrid approaches. Clinician-directed therapy is when the session is directly controlled by the clinician (Fey, 1986). The clinician decides the session goals, when and where the session will take place, what stimuli are to be presented, how often and what reinforcement will be given, and which responses that the child provides within the session are correct (Fey, 1986). Stimuli and behaviours that are not desired within the session are suppressed. Modelling is one technique that is used in this approach. The clinician-directed approach intends to make changes to the child that are specific. As a result this approach is the least natural out of the three and a disadvantage of the clinician-directed approach is that the behaviours or goals achieved in clinic are hard to generalise to the outside world (Fey, 1986).

The child-directed approach is when the relationship between the child and adult is modified so the child is seen as an equivalent when communicating (Fey, 1986). The child directs the structure of the session with the goal being to create an environment that will naturally encourage the child to talk. From this, specific behaviours are addressed (Fey, 1986). There are three key aspects to this approach. These are that the clinician needs to: (i) wait for the child to instigate the action desired; (ii) judge this action to be a desire to communicate (even if that was not what the action was originally for); and (iii) respond in a way that will facilitate speech and language development (Fey, 1986).

The hybrid approach integrates both of the previous approaches. For the hybrid approach, when engaged in a natural play situation, the clinician will follow the child's lead. However the clinician will purposely alter the environment to ensure that the maximum amount of opportunities are provided for the child to produce the target vocabulary or communication behaviour (Fey, 1986). There are three key areas that are encompassed when using the hybrid approach. These are: (i) the

clinician will have some specific goals; (ii) the clinician will use toys and stimuli that will most likely elicit the target response; and (iii) the clinician will modify their language so that the target goals are used and highlighted (Fey, 1986). Techniques such as modeling, directing the child to a specific item in play, and reinforcing the language targeted when talking to the child are also used (Fey, 1986). Another strategy that is used for the hybrid approach is facilitative play. This is where the clinician manipulates the environment so the child is encouraged to produce and use the target behaviour while not being directly requested to do so (Fey, 1986). The clinician will also produce a high number of the target behaviour in the play context through the use of expansions and parallel talk (Fey, 1986). Research has indicated approaches that are more naturalistic can be of more benefit to young children, particularly when their MLU is three morphemes or less (Yoder & Warren, 1998).

It is difficult to determine which approach is the more effective or valid. The child, family and who will be carrying out the intervention all need to be considered to ensure the best result possible (Gillon, Moran & Page, 2007). Fey (1986) stated that when considering which treatment approach to use, it is important to consider the amount of naturalness used in that approach. This is because the more natural the approach is, the more generalisation into other environments that is likely to occur (Fey, 1986). Generalisation is a major consideration when working with children with language delay. Therapy is often provided in a clinical environment which can be quite different to the school or home environment and the carry-over of skills can be difficult (Kouri, 2005). More naturalistic approaches place further emphasis on the child being able to use their new communication skills successfully in a social setting (Fey, 1986). Kouri (2005) investigated the effectiveness of mand-elicited imitation and modeling with auditory bombardment on a group of late-talking children and children with developmental disabilities. Kouri's study (2005) used two elements of two approaches in order to isolate the different degrees of naturalness of each approach to determine which approach was more effective. The mand-elicited imitation condition used elicitations and imitative prompts to increase the child's use of vocabulary and lexical knowledge. The modeling with auditory bombardment condition used a play situation in which the child was not required to produce a response. The target was modelled frequently and auditory bombardment was used at the beginning of each session. The results of the study showed no significant difference between the mand-elicited imitation and the auditory bombardment conditions. However, the mand-elicited imitation condition proved to be better at eliciting the target vocabulary with children showing higher rates of

learning within the treatment session (Kouri, 2005). There was no difference found between the two conditions when generalisation to the home setting was investigated (Kouri, 2005). In summary, Kouri found that both conditions were effective in teaching vocabulary when they were incorporated in a more natural setting (Kouri, 2005).

Fey, Long & Finestack (2003) outlined some key principles for grammar intervention for children with language delay. Before intervention begins, four areas must be considered in order to tailor intervention to the child and obtain the best outcomes (Fey et al., 2003). These four areas are to assess the child's current speech and language abilities, to postulate the reason why the delays may have occurred, to assess how these delays are currently affecting the child's social and academic functioning, and how these may proliferate in the future (Fey et al., 2003). The four areas encompass the basic goal for any intervention program targeting language delays in children; to assist the child to effectively communicate their wants and needs and prevent any present or future social, academic, or behavioural problems (Fey et al., 2003). These four areas and principals combine to form the hybrid intervention technique used in this paper that focuses on structured teaching and focused stimulation. Some important principals to consider when working with children with hearing impairment and that have been followed in this paper are discussed below.

A principle used in this paper that can be used with children with hearing impairment states that rather than targeting specific language forms, the therapist should choose intermediate goals that will tempt the child to communicate. This implies that clinicians should target general, functional language forms that will generalise to other environments and assist the child in acquiring more advanced language forms. Research indicates that by targeting vocabulary and increased verb production, there is a carry-over effect into increased MLU and an improvement in phonological awareness (Gillon et al., 2007).

The environment can be altered to create increased opportunities for communication (Fey et al., 2003). That is the environment and activities can be manipulated within the therapy session in such a way to promote the maximum opportunities for the target vocabulary to be produced. For example, storybooks would only be chosen if they contained the target vocabulary.



Children with hearing impairment need a more significant contrast in auditory signals when listening to speech and language. Fey et al. (2003) states the easiest way to make vocabulary targets more salient within a therapy session is to increase the stress, make the word longer, say the word at an increased intensity, and use increased dynamic pitch changes. An additional technique is to make a forced contrast between two words, one containing the target word form, as the target will naturally be used with more stress than the non-target (Fey et al., 2003). These techniques are important and are easily accomplished during storybook reading (Fey et al., 2003). Even when provided with appropriate amplification, children with hearing impairment may not be hearing within normal limits (Geers, 2004). They will be missing out on some key auditory information pertinent to language development (Geers, 2004). The child may still have the equivalent of a mild hearing loss (Ertmer & Mellon, 2001). Children with even a mild hearing impairment have been shown to exhibit delays in language acquisition and later academic achievement (Ertmer & Mellon, 2001).

The way the clinician talks within the intervention session can be manipulated to highlight various target vocabulary (Fey et al., 2003). This involves use of recasts and avoiding use of telegraphic speech. Recasts act to focus on grammatical forms where what the child says is reformulated by the clinician to be more grammatically appropriate. Recasts are generally a more naturalistic alternative to modeling (Fey et al., 2003). The use of telegraphic speech is strongly advised against as children are more receptive to full grammatical sentences before they are able to produce themselves (Fey et al., 2003).

For children with hearing impairment, the use of elicited imitation makes target words more salient (Fey et al., 2003). A child needs to be provided with lots of opportunities to practice the word or phonological forms they find difficult (Fey et al., 2003). When incorporated with other intervention techniques, elicited imitation is effective in contrasting the connection between form and function (Cleave & Fey, 1997). To be able to effectively master vocabulary, the child needs both to be able to produce and understand the word.

Intervention targeting vocabulary has received some attention in research. Focused stimulation is one intervention technique that has been investigated as a way to remediate vocabulary and

language delays. Girolametto et al. (1996) conducted a study using focused stimulation to remediate expressive language delays in young toddlers. The researchers designed an intervention program in which the parents were the primary intervention administrators. Three types of techniques were taught to the parents for focused stimulation. These were child-directed approaches where frequent opportunities were created for the child and parent to engage in an activity that the child was interested in; techniques when the child and parent were treated as equal communication partners, such as turn-taking and joint interaction; and modelling that conveyed the link between language form, content and use (Girolametto et al., 1996). Focused stimulation was used because it provided frequent opportunities for the language target to be given in relatively naturalistic settings in which the child is interested in (Fey, 1986). The results of the study indicated that the children, when compared to the control group, made significant gains in vocabulary that could not be explained by maturation alone (Girolametto et al., 1996). The results also supported the rationale for vocabulary intervention for children with delays in vocabulary (Girolametto et al., 1996). The researchers found that children in the study generalised the vocabulary taught during focused stimulation to learning new words (Girolametto et al., 1996). By increasing vocabulary carry-over effects were also seen in reducing behavioural problems and increasing the development of symbolic play (Girolametto et al., 1996). Overall, language intervention programs that target vocabulary and auditory-verbal methods have been associated with good results for children with language delay (Goldberg & Flaxer, 2001).

The hybrid language intervention program used in this paper has been previously used on a child aged 3;0 years with cleft palate (Page & Moran, 2007). According to Page & Moran (2007) children with cleft palate can experience language delays including impaired vocabulary and MLU as well as obvious speech and articulation difficulties. A selection of ten verbs were chosen for the intervention based on pre-intervention assessment measures. These verbs were not already in the child's vocabulary. The verbs were targeted over a five week period of hybrid intervention. At the conclusion of the intervention pre- and post-assessment scores were compared. The child exhibited acquisition of the ten verbs both within the clinic and in the home environment, indicating intervention had generalised (Page & Moran, 2007). Additional receptive and expressive language assessment indicated that the child also had an overall increase in MLU (Page & Moran, 2007).

## Summary

The ultimate goal for children with hearing impairment is to provide them with the best hearing and habilitation strategies to enable them to develop speech and language skills in accordance with their age-matched peers (Blamey et al. 2001). By developing age-appropriate skills it is intended that children with hearing impairment will be able to enter mainstream schooling and be able to function independently in the wider community (Blamey et al. 2001). The ability to achieve speech and vocabulary competency are important markers of a child's ability to communicate and influences their future success (McDonald-Connor et al. 2006). It has been stated that habilitation programs that focus on prompting language and encompass vocabulary have resulted in positive outcomes for children with cochlear implants (Goldberg & Flaxer, 2001). Therefore, the aim of this project is to evaluate a vocabulary intervention program that could be used to help children with hearing impairment who wear either a cochlear implant or hearing-aid and have an expressive language delay. It is intended that by targeting vocabulary development, both spoken and receptive language will be improved (Gillon et al. 2007).

It is hypothesised that children with hearing impairment will demonstrate improvement in expressive language as measured by mean length of utterance (MLU), the number of different words used in conversational language and expressive vocabulary after ten treatment sessions.

## **Method**

### Design

This study is a single subject design across behaviours (Portney & Watkins, 2000). This design enables control over the experiment and the ability to observe changes occurring under treatment conditions. Single-subject designs are particularly effective for homogeneous groups such as children with hearing impairment. The independent variable in this study was the vocabulary intervention. The dependent variable was the participant's response. Specifically, the production of target verbs, MLU in morphemes and the number of different words obtained from a spontaneous language sample.

### Participant Recruitment

A total of three children participated in this study. Participants were recruited through the regional Advisors of Deaf Children. Letters of invitation to participate in the study were sent out to twenty children. All participants met the following selection criteria:

- a) Participants were required to have a language delay which was defined as 1.25 standard deviations below the mean on at least two subtests of the Clinical Evaluation of Language Fundamentals-Preschool (CELF-P) and/or one subtest of the CELF-P as well as the other standardised tests (Ellis Weismer et al. 2000). The CELF-P is a standardised clinical test of expressive and receptive language (Wigg, Secord & Semel, 1992);
- b) Children needed to have received amplification (either a cochlear implant or hearing aid) for at least one year and have a severe to profound hearing loss;
- c) If a participant had a cochlear implant they needed to have the same model cochlear implant, use the same speech processing strategy in their speech processor and have had no anomaly with their implant;

## Participants

There were a total of three participants who took part in this study. Participants were aged 4;5 years, 5;4 years and 10;5 years. Two monolingual, English-speaking children with hearing impairment and one bilingual child with hearing impairment participated in the study. Individual details of each participant are provided in the Results section. Although all the participants had a unique pattern of hearing loss, two of the participants were similar in that both wore hearing aids. The third participant in the study, however, differed from the other two in that she wore a cochlear implant and spoke English as a second language. The implications of these factors for Participant Three are discussed later in the paper.

## Procedures

Assessment and intervention procedures took place in a clinic with quiet surroundings at the University of Canterbury's Department of Communication Disorders and two other local schools within Canterbury. The principal investigator was responsible for administering assessments, intervention and collating the results.

This study involved three phases: 1) A baseline phase prior to intervention; 2) An intervention phase during which time vocabulary therapy was provided; and 3) A post-intervention phase which took place one week after the intervention.

## *Assessment and Baseline Phase*

Assessment before intervention included a case history and standardised tests for language assessment. Assessment took place approximately one week before baseline testing commenced. The standardised tests included the Peabody Picture Vocabulary Test-III (PPVT) and the MacArthur-Bates Communication Developmental Inventory (CDI). For assessment of general expressive and receptive language, the Clinical Evaluation of Language Fundamentals-Preschool edition was used (CELF-P). A criterion-referenced assessment was in the form of a 50 utterance

conversational language sample taken from a play situation. Below a brief explanation of the purpose of each test is provided.

*Standardised Assessment:* The Peabody Picture Vocabulary Test-III is designed to assess receptive language skills. It requires the child to point to the correct picture on a page when asked to point to the desired item. There are four pictures per page. This is a test that provides standard score equivalents, percentile ranks, normal curve equivalents and stanines corresponding to standard scores (Dunn & Dunn, 1997). This test needs minimal verbal response and no reading or writing is needed. The test takes approximately 16 minutes and items are tested in groups of 12. The phrase used to elicit the participant's response is in the form of "Show me the ....." (Dunn & Dunn, 1997). The test is begun by starting at the appropriate chronological age. A basal set needs to be established first. This is where the participant produces one or no errors (Dunn & Dunn, 1997). A ceiling set is then established, where the participant produces eight or more errors (Dunn & Dunn, 1997). A raw score is then calculated and converted to age equivalents (Dunn & Dunn, 1997).

The MacArthur-Bates Communication Developmental Inventory (CDI) is a parental questionnaire where parents classify words and sentences that their child uses from given examples (Fenson et al., 1993). The Words and Sentences questionnaire is recommended and normed for children aged 16 to 30 months (Fenson et al., 2007). The participants in this study were older than the recommended age range. Thal, Desjardin & Eisenberg (2007) conducted a study looking at the CDI on children who were outside the recommended age range and were delayed in language development. They found moderate to large correlations between the score obtained on the CDI and standardised language measures (Thal et al., 2007). The CDI has also been validated for use on older children with cochlear implants to monitor and record milestones in language development (Lee, Chiu, van Hasselt & Tong, 2009). For this paper, the inventory was used to gain a better understanding of the vocabulary and verbs each participant was using.

*General Expressive and Receptive Language:* The Clinical Evaluation of Language Fundamentals-Preschool is a test of expressive and receptive language with the requirement of pointing to pictures and producing various language forms (Wiig et al., 1992). This was administered in accordance with the administration manual, meaning that a single examiner both

administered and scored the test. There are five subtests within the CELF-P. These are linguistic concepts, sentence structure, basic concepts (receptive language) and recalling sentences, formulating labels and word structure (expressive language) (Wiig et al., 1992). Three manuals are provided which contain the picture stimuli needed for each test. On completion of the subtests three composite scores are obtained; these are receptive language, expressive language, and a total language score (Wiig et al., 1992). Composite scores can then be compared to norm scores to enable judgement of whether a child is delayed in comparison to their normal peers (Wiig et al., 1992).

*Criterion-referenced Assessment:* A language sample was obtained by engaging the child in a play situation and recording their expressive language. The recording was made using a Panasonic digital video recorder (Model SDR-H250). A minimum of 50 utterances is needed for a language sample. This involved providing to the participant toys of interest for pretend play or a game (depending on their age). Then the principal investigator followed the child's lead in respect to pretend play. Instruction on how to collect a language sample was taken from Miller (1981). The language sample was then analysed using the Systematic Analysis of Language Transcripts (SALT) (Westerveld, 2003) to gain further information as to the participants' stage of language development. Specifically, MLU and number of Different Words were calculated.

*Hearing Thresholds:* Audiological information, including hearing thresholds, was gathered from each participant's audiologist. All testing information was current to within three months of beginning the baseline phase and included aided thresholds and tympanometry recordings.

### Baseline Testing

After the initial assessments were completed baseline testing was started. This included probing the target vocabulary during three 20 minute sessions over a period of three weeks. Baseline testing was completed to obtain a stable recording of the participants' ability to use the target verbs. The target verbs were selected using the MacArthur-Bates Communication Development Inventory and probing with picture cards that depicted specific verbs. The verbs used for baseline testing and intervention for each participant are provided in Appendix 2. The probe involved the participant being shown a picture and asked to describe what was happening in the picture. No corrective



feedback or prompting was used, however children were reinforced for responding by comments such as “well done” or “good try”. All utterances that the participant produced were recorded using a Panasonic digital video recorder (Model SDR-H250). Language samples taken were analysed using the SALT transcription software.

### Intervention Phase

Intervention after the baseline phase involved two 60 minute sessions per week for five weeks. Intervention was administered by the principal investigator. A hybrid approach was used (Fey, 1986). Intervention was conducted in a quiet clinic at the Communication Disorders Department at the University of Canterbury and two local schools within the Canterbury region.

The intervention targeted the ten verbs established at the initial assessments that the child was not already producing. Although the aim of this therapy was to improve vocabulary, the sessions incorporated the principles of grammatical intervention outlined by Fey et al. (2003). One such principle is to provide frequent models of the target words to the child in order to promote the development of grammatical structures (Fey et al., 2003). All intervention sessions began with five minutes of structured teaching where the target verbs were shown on picture cards, and the participant was asked to produce the word. If the participant was unable to name the pictured verb, elicited imitation was used whereby the principal investigator modelled the word and then asked the participant to produce it. A child with language delay needs to be provided with lots of opportunities to practise the word or phonological form that they find difficult (Fey et al., 2003). Elicited imitation is one way that this can be achieved. The remainder of the session utilised a focused stimulation approach (Fey et al., 2003) using a variety of materials including story books and toys. The first focused stimulation activity was interactive storybook reading using stories containing the target vocabulary. The participant was not required to produce the targets but was required to pay attention while the story was being read. This context provided an opportunity for a high number of models of the target vocabulary to be provided in a way that was meaningful and relevant.

Finally, the principal investigator and participant engaged in focused stimulation play with toys where the participant had a number of opportunities to hear and produce the target verbs. The

principal investigator provided a high numbers of salient models and used expansions and recasting when appropriate. The participant was also encouraged to produce the target vocabulary by being presented with situations which required obligatory responses. If the participant did not respond, the principal investigator provided the appropriate model. The outline used for the focused stimulation section of the intervention can be found in Appendix 2.

A language sample was taken throughout each session with analyses carried out at a later date.

### *Post-intervention Phase*

The post-intervention phase was conducted over two sessions, one week apart, following the intervention. The post-intervention phase involved probes being administered of the target vocabulary. Toys that were used in the intervention were present for the post-intervention phase, but all intervention was withdrawn. The principal investigator did not use hybrid language techniques such as modelling and recasting. Another language sample was taken approximately one week after the conclusion of the intervention phase. The participant's utterances were recorded and transcribed using SALT to establish whether the participant was using the target vocabulary spontaneously and whether an increase in MLU had occurred as a result.

## Reliability

### *Dependent Measures*

Calculations of MLU in morphemes and the number of different words in this study were obtained from conversational language samples. This occurred at each session with each participant to enable measures of progress to be made. To obtain transcription reliability a second independent, qualified Speech and Language Therapist was recruited. 40% of the total number of language samples from the baseline and post-intervention phases for the three participants were re-transcribed. Transcription agreement was calculated on a point-by-point basis. Transcription reliability was calculated to indicate an inter-rater reliability of 85%.

### *Procedural Fidelity*

The ability of the principal investigator to follow the hybrid language intervention program was investigated to ensure procedural fidelity. Intervention sessions were rated by an external rater who was a qualified Speech and Language Therapist in her Doctoral studies. 20% of the intervention sessions for the participants were scored in terms of structured teaching, focused stimulation and structured teaching in context. The outline for this intervention structure can be found in Appendix 2. Procedural fidelity was calculated to indicate that the principal investigator was able to follow the intervention outline reliably to 100%.

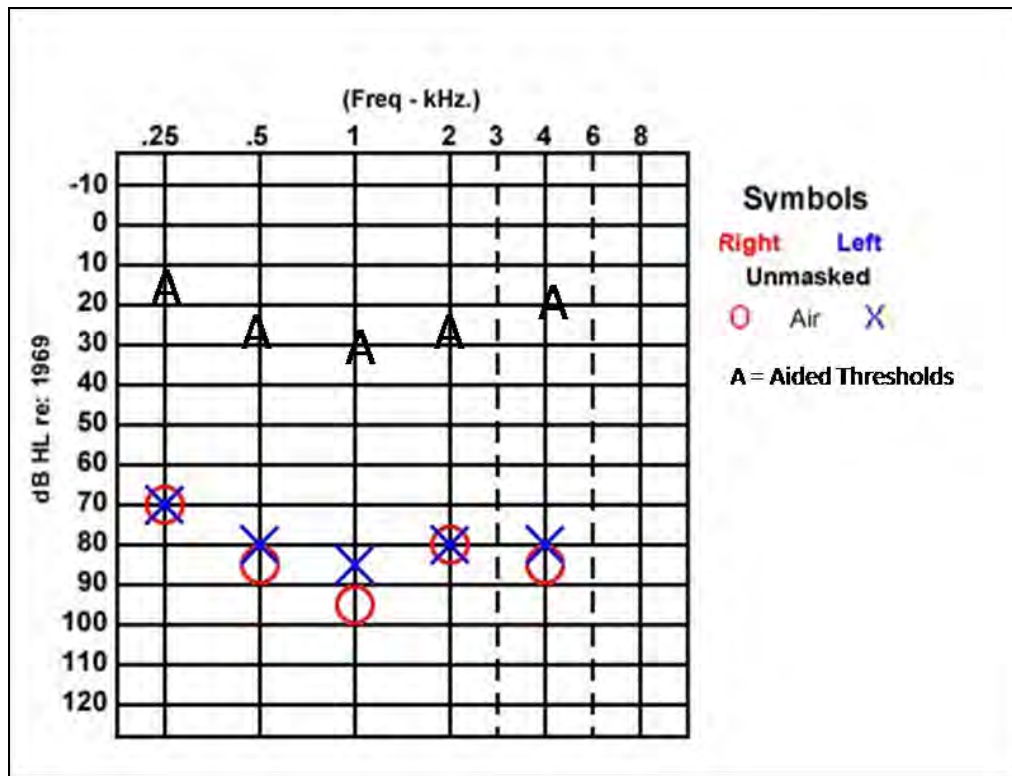
## Results

Results were plotted to compare how each participant performed in the intervention and post-intervention phase to the baseline testing phase. All participants improved significantly on their ability to produce the target words. One participant demonstrated significant improvement in the different number of words used in a conversational language sample. Contrary to expectation, significant differences were not noted for MLU in morphemes for any of the participants. Detailed results for each participant are shown below. Each diagram is shown using the two-standard deviation band method, to assist in determining whether the results obtained were significant (Portney & Watkins, 2000).

### Hearing Aid Participants

#### *Participant One*

Participant One was a monolingual, English speaking female aged 5;4 years. She passed her newborn hearing screen overseas. Participant One was first fitted with hearing aids aged 2;4 years. At the time of testing the participant had a moderately-severe to profound sensorineural hearing loss. Figure 1 depicts Participant One's aided and unaided thresholds. Participant One's audiologist, along with other medical personnel believed the hearing loss to be progressive in nature since birth but to have stabilised in the last two years. Participant One wore bilateral Phonak Aero 311 Azf behind-the-ear hearing aids with attached FM system boots. The FM system was utilised in her school classroom during school hours. At the time of testing Participant One was receiving 4 hours per week teacher aide time and 4 hours per week Teacher of the Deaf time. This service time focused primarily on literacy development. No other speech and language therapy was being administered at the time of testing. Previous speech and language therapy included intervention at age 3;4 years. The focus of this was on word development and parental modelling.



**Figure 1.** Participant One's unaided and aided thresholds.

The results of the initial assessments are seen in Table 2 below. In general the language assessments indicated the presence of a language delay.

Results from the MacArthur Bates Communication Inventory (Fenson et al., 2007) indicated that Participant One was using more descriptive words (adjectives) than action words (verbs). This result was reinforced by the CELF-P subtest scores where the word structure subtest was particularly low for receptive language.

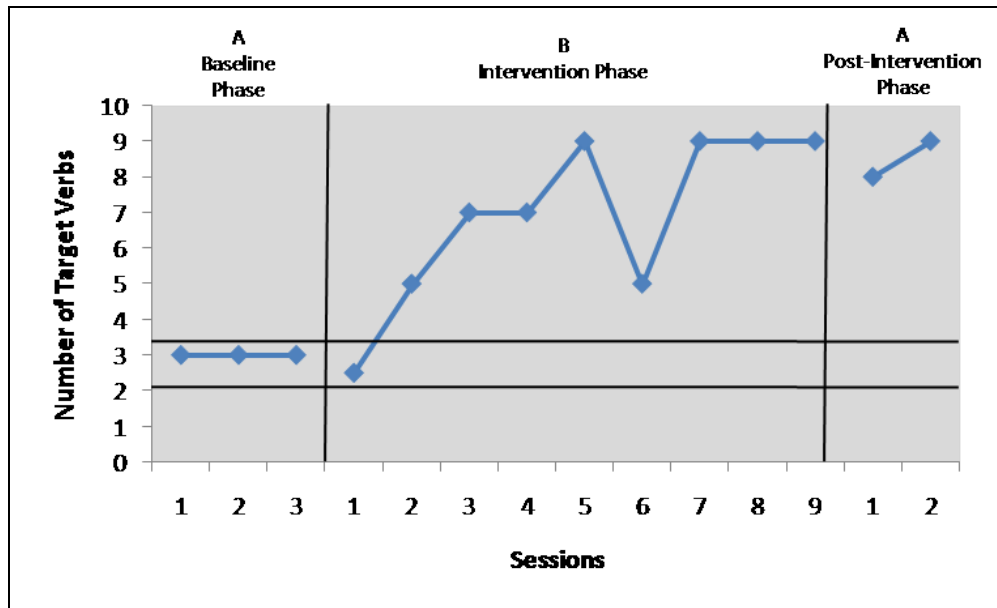
**Table 2.** *Language profile of Participant One.*

Participant	<b>1</b>
Age in Months	64
<u>PPVT</u>	92 <sup>a</sup>
<u>CELF-P</u>	
Linguistic concepts subtest	3 <sup>b</sup>
Basic concepts subtest	7 <sup>b</sup>
Sentence structure subtest	3 <sup>b</sup>
CELF-P Receptive Language Score	69
Recalling sentences in context subtest	4 <sup>b</sup>
Formulating labels subtest	7 <sup>b</sup>
Word structure subtest	3 <sup>b</sup>
CELF-P Expressive Language Score	71
<u>50 Utterance Language Sample:</u>	
MLU in Morphemes	2.76
Number of Different Word Roots	86

Note: <sup>a</sup> *Peabody Picture Vocabulary Test Standard Score. Mean standard score for PPVT is 100 with a standard deviation of 15;* <sup>b</sup> *Clinical Evaluation of Language Fundamentals – Preschool Standard Score. CELF-P mean standard score is 10 with a standard deviation of 3.*

### Vocabulary Targets

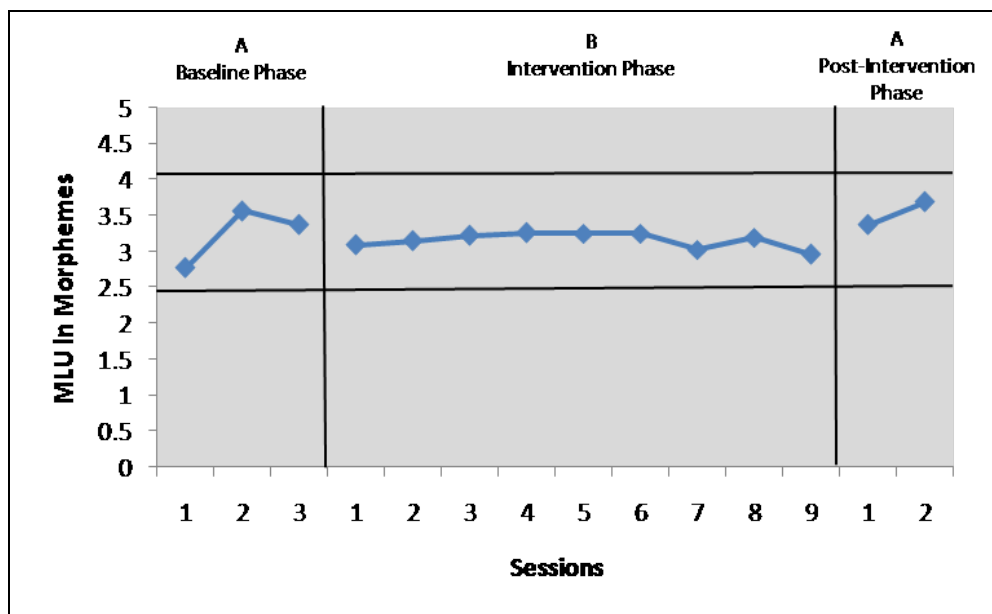
The purpose of this intervention was to investigate whether by targeting vocabulary and specifically verbs, an increase would be seen in the number of verbs used by each participant. Figure 2 depicts the number of target verbs used by Participant One during the three phases of the study. Participant One increased her use of target verbs. In baseline testing Participant One named an average of three of the ten target verbs during a picture-naming probe task. During intervention, target verb use increased to nine out of ten verbs on the probe measures. Use of the target verbs was also evaluated at a period of seven and ten days following intervention. Participant One named significantly more target verbs post-intervention compared to pre-intervention (baseline phase).



**Figure 2.** *Number of target verbs produced by Participant One.*

### Mean Length of Utterance

It was hypothesised that by specifically targeting and training a set number of verbs, a follow-on effect would occur where MLU would be increased. MLU in morphemes was evaluated before, during and following intervention, to determine whether improved vocabulary resulted in changes in MLU. As shown in Figure 3, there was no significant difference in MLU across the testing phases for Participant One.

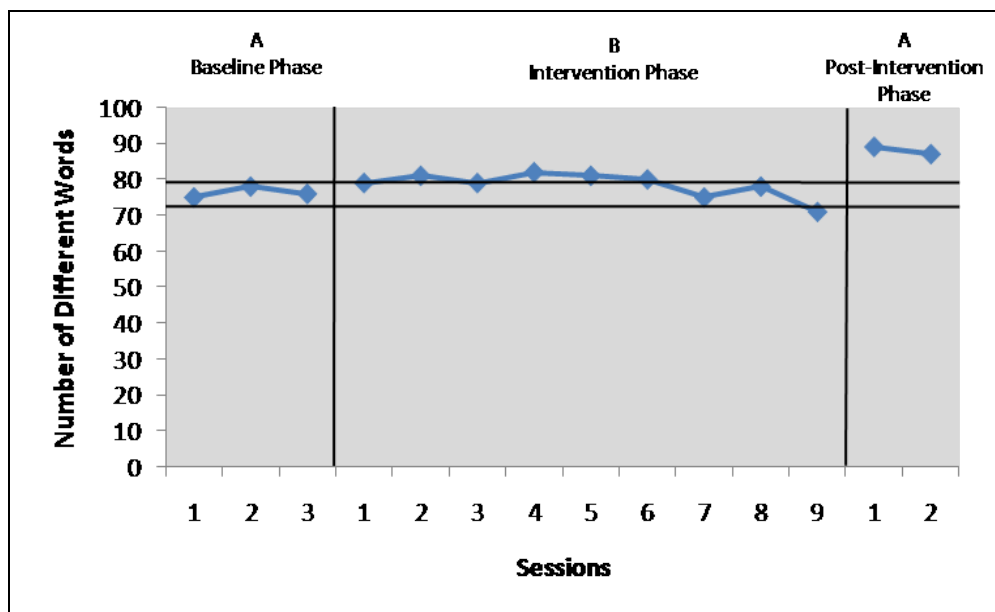


**Figure 3.** *MLU in morphemes for Participant One.*



### Different words in Language Sampling

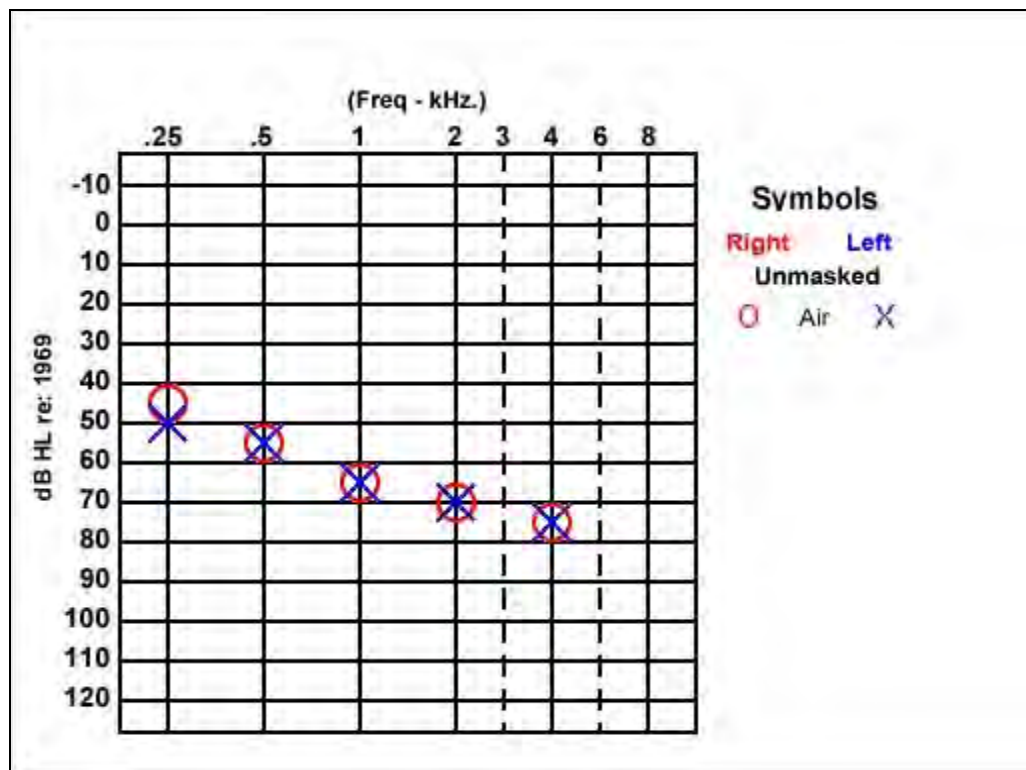
During the intervention phase new words were introduced into the participant's vocabulary. The number of different words used by each participant in conversational language samples was assessed to see whether this increased during the three phases. A significant increase in number of different words used occurred in the post-intervention phase for Participant One. This increase was not seen in the baseline or intervention phases. This is shown below in Figure 4.



**Figure 4.** *Use of number of different words for Participant One.*

### *Participant Two*

Participant Two was a monolingual, English speaking male aged 4;5 years. Participant Two was born premature at 24 weeks and was given the ototoxic antibiotic Gentamycin as a life saving technique. Hearing loss occurred as a result. Participant Two received his first set of hearing aids at approximately 12 months. At the time of testing, Participant Two had a moderate sloping to severe sensorineural hearing loss. Figure 5 depicts Participant Two's unaided thresholds. No aided thresholds are shown due to testing difficulties with Participant Two. Participant Two's hearing fluctuated during the research due to his susceptibility to Otitis Media. Participant Two wore bilateral Oticon Atlas behind-the-ear hearing aids. He did not have an FM system but was due to be fitted with one at the end of testing in preparation for school. At the time of testing, Participant Two had an itinerant teacher at his preschool and was receiving no other speech and language therapy services.



**Figure 5.** *Participant Two's unaided thresholds.*

The initial language assessment results are provided in Table 3 below. Language assessments indicated the presence of a significant language delay.

The MacArthur Bates Communication Inventory indicated Participant Two was using more descriptive (adjectives) and naming (nouns) words than action words (verbs). This result was reinforced by the CELF-P and language sampling.

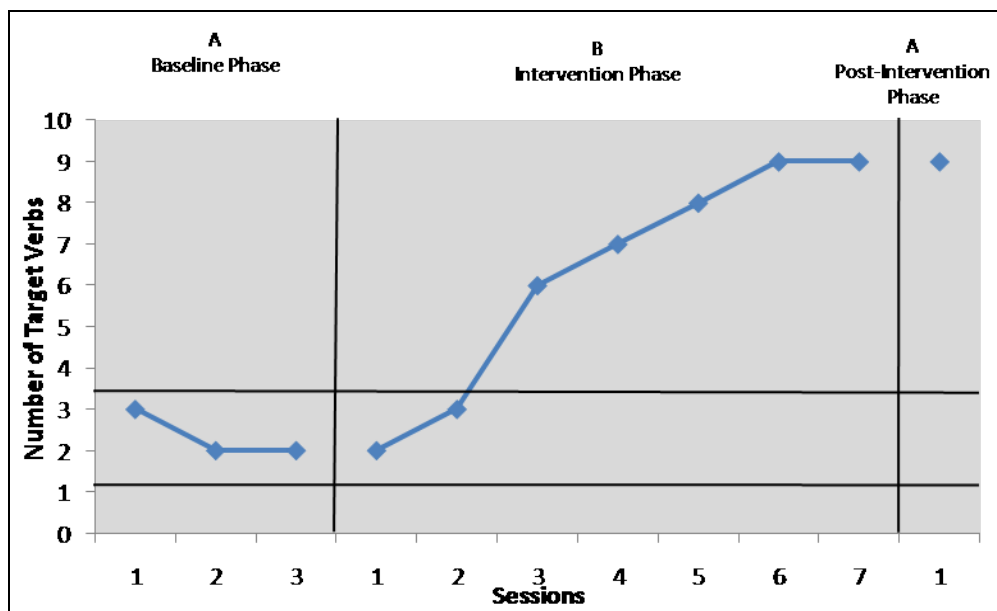
**Table 3.** *Language profile of Participant Two.*

Participant	2
Age in Months	53
PPVT	66 <sup>a</sup>
<u>CELF-P</u>	
Linguistic concepts subtest	3 <sup>b</sup>
Basic concepts subtest	3 <sup>b</sup>
Sentence structure subtest	3 <sup>b</sup>
CELF-P Receptive Language Score	50
Recalling sentences in context subtest	3 <sup>b</sup>
Formulating labels subtest	7 <sup>b</sup>
Word structure subtest	3 <sup>b</sup>
CELF-P Expressive Language Score	69
<u>50 Utterance Language Sample:</u>	
MLU in Morphemes	3.32
Number of Different Word Roots	66

Note: <sup>a</sup> *Peabody Picture Vocabulary Test Standard Score. Mean standard score for PPVT is 100 with a standard deviation of 15;* <sup>b</sup> *Clinical Evaluation of Language Fundamentals – Preschool Standard Score. CELF-P mean standard score is 10 with a standard deviation of 3.*

### Vocabulary Targets

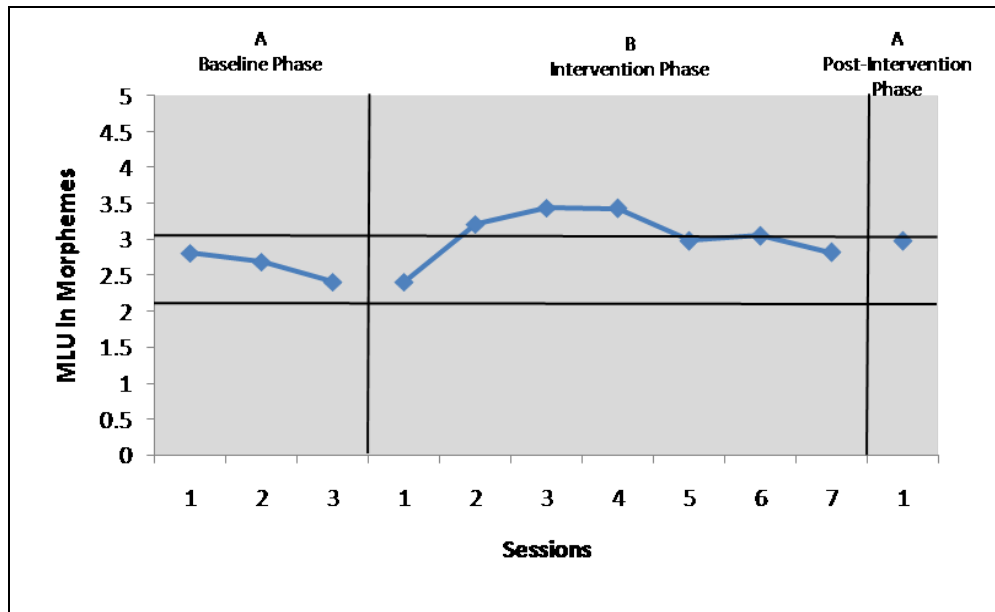
Participant Two significantly increased his use of target verbs. Figure 6 depicts the number of target verbs named by Participant Two on the verb probe task. This figure shows that in the baseline testing phase Participant Two named between two to three of the target verb probes. This increased to being able to correctly name nine out of the ten verb probes consistently by the post-intervention phase. The result indicates that naming of the target verbs was not affected by Participant Two's bilateral ear infections. Participant Two only had one post-intervention phase session due to family commitments that could not be controlled for.



**Figure 6.** *Number of target verbs produced correctly by Participant Two.*

### Mean Length of Utterance

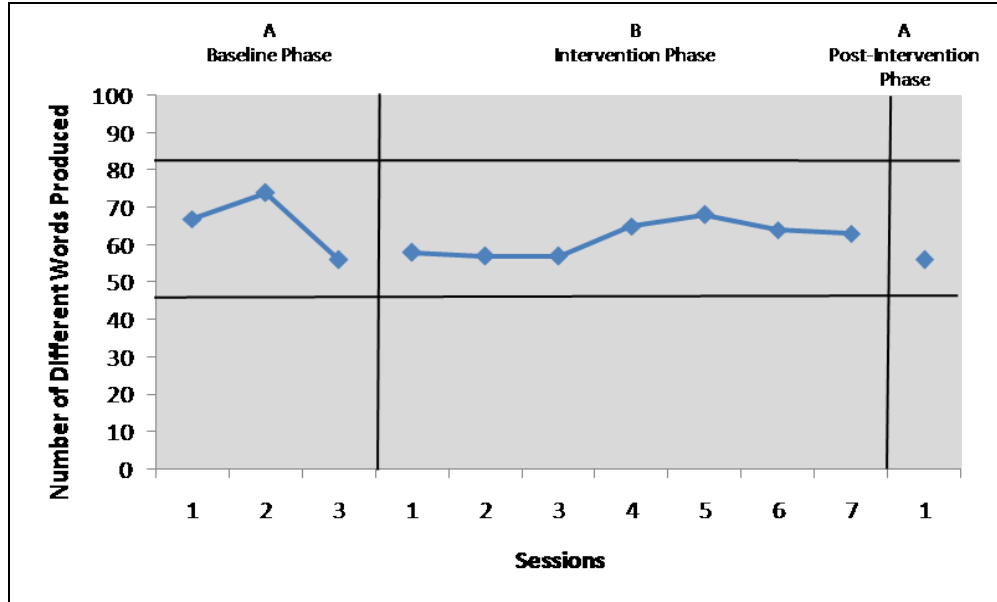
It was hypothesised that by specifically targeting and training a set number of verbs, a follow-on effect would occur where MLU would be increased. Participant Two did show a significant increase in MLU during intervention and was on the border of two standard deviations above the baseline mean at post-intervention assessment (see Figure 7). The decrease in performance at approximately session six for Participant Two very likely could have been due to the presence of bilateral ear infections during this time. The decrease in MLU at session five could be attributed to Participant Two only wearing one hearing aid as the other was in for repair. Participant Two's hearing aid was repaired and in working order when he attended session six.



**Figure 7.** *MLU in morphemes for Participant Two.*

### Different words in Language Sampling

Different number of words was investigated in each participant's conversational language samples to see whether an increase was seen in the number of different words used during the three phases. Despite a significant increase in target verbs produced following intervention, there was no difference in number of different words used in conversational language samples collected before, during and post-intervention for Participant Two. This is depicted in Figure 8. Participant Two had a complicated medical history and was prone to middle ear problems. During the three phases Participant Two was on the waiting list for the insertion of a second pair of grommets and the removal of his adenoids. At approximately session six Participant Two was observed to have more difficulty hearing and had difficulty remaining on task. His mother reported that at night with his hearing aids off Participant Two seemed to be "more deafer than usual". During the rest of the intervention and post-intervention phases Participant Two had medically diagnosed, bilateral Otitis Media and was on antibiotics.

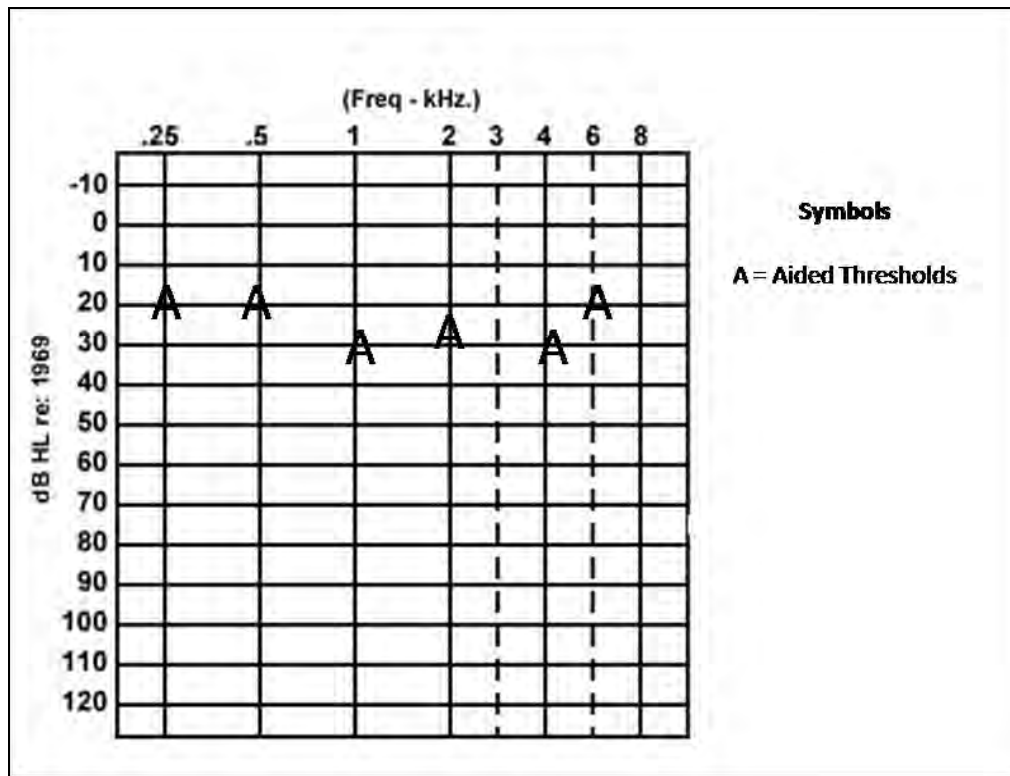


**Figure 8.** *Use of number of different words for Participant Two.*

## Cochlear Implant Participant

### *Participant Three*

Participant Three was a female aged 10;5 years. She was a cochlear implant user of five years. Participant Three was born overseas and was exposed to Kurdish and Farsi language until aged 3;0 years. Although she has been in New Zealand for approximately seven years, English was not spoken at home. Participant Three knows only minimal key phrases in her native language. Her hearing loss was not diagnosed until she arrived in New Zealand aged approximately 3;0 years. It is thought at this time she was not speaking in her native language. Participant Three trialled hearing aids for approximately 18 months after her diagnosis of hearing loss, but received little benefit from them. She was implanted with a Cochlear Nucleus 24 implant in 2003 in her right ear. Participant Three had no residual hearing in her left ear. Before implantation Participant Three had no usable hearing in either ear and her responses to audiological testing were vibrotactile. At the time of testing she was using an ear level Cochlear Freedom processor with the ACE processing strategy and Phonak Zoomlink FM system. She did not wear a hearing aid on the other ear. At the time of testing Participant Three was receiving 8.5 hours per week teacher aide time, 3.5 hours per week Teacher of the Deaf time, and 0.5 hours a week ESOL (English as a Second Oral Language) time. This time was devoted to assisting her in the classroom to enable her to participate in classroom activities to the best of her ability. Figure 9 depicts Participant Three's aided thresholds.



**Figure 9.** *Participant Three's aided thresholds.*

The initial language assessment results are provided in Table 4 below. Language testing at the initial assessment indicated the presence of a significant language delay.

The MacArthur Bates Communication Inventory was not able to be completed for Participant Three as the inventory was written in English and English was not spoken in the child's home. The inventory was given to Participant Three's educational carers. Unfortunately due to timetables and educational commitments this could not be completed. Because of this the verbs to be targeted during the intervention phase were chosen based on probing with an extensive range of verb cards and examining Participant Three's language responses from the CELF-P standardised test.



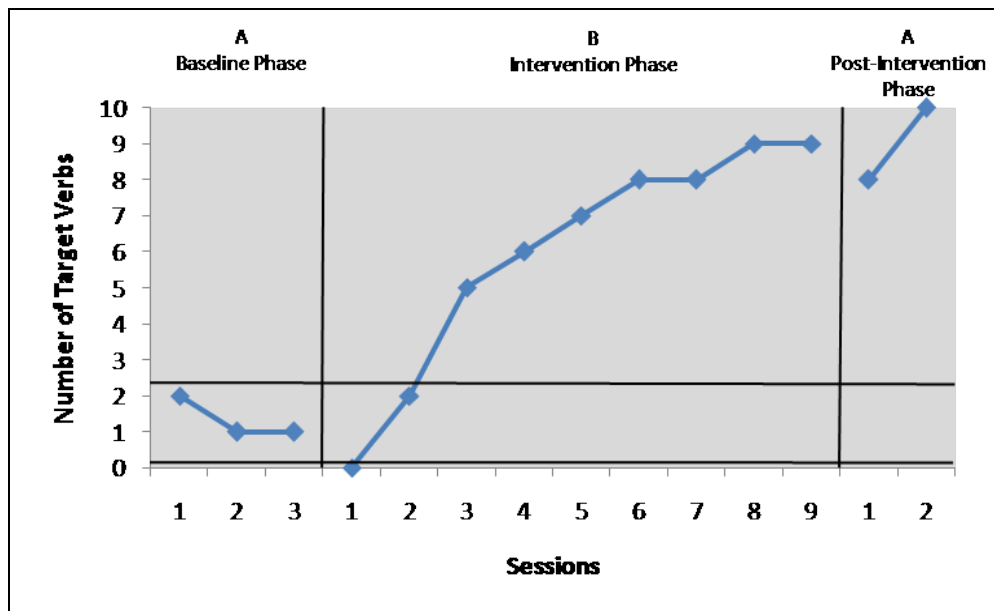
**Table 4.** *Language profile of Participant Three.*

Participant	<b>3</b>
Age in Months	125
<u>PPVT</u>	44 <sup>a</sup>
<u>CELF-P</u>	
Linguistic concepts subtest	3 <sup>b</sup>
Basic concepts subtest	6 <sup>b</sup>
Sentence structure subtest	3 <sup>b</sup>
CELF-P Receptive Language Score	67
Recalling sentences in context subtest	3 <sup>b</sup>
Formulating labels subtest	3 <sup>b</sup>
Word structure subtest	3 <sup>b</sup>
CELF-P Expressive Language Score	50
<u>50 Utterance Language Sample:</u>	
MLU in Morphemes	3.11
Number of Different Word Roots	53

Note: <sup>a</sup> *Peabody Picture Vocabulary Test Standard Score. Mean standard score for PPVT is 100 with a standard deviation of 15;* <sup>b</sup> *Clinical Evaluation of Language Fundamentals – Preschool Standard Score. CELF-P mean standard score is 10 with a standard deviation of 3.*

### Vocabulary Targets

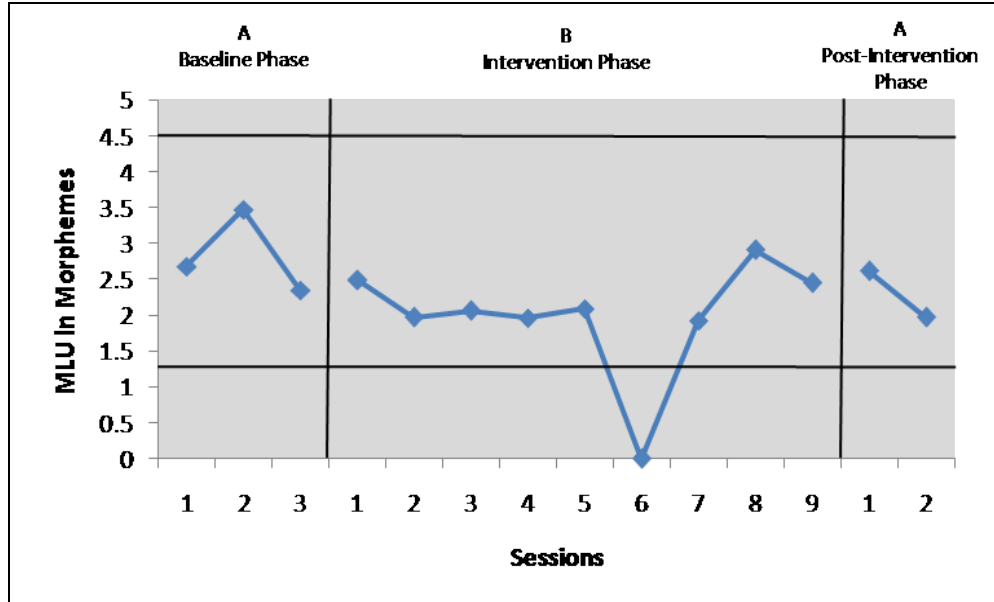
Language samples were collected for Participant Three in the baseline, intervention and post-intervention phases. Participant Three's conversational dialogue was restricted somewhat so language sampling was taken throughout the session. These sessions were approximately 30-40 minutes in length. For 50% of the language samples a full 50 utterance set could not be obtained, therefore affecting the validity of the results. Figure 10 depicts the number of target verb probes Participant Three was able to correctly identify during the three phases of testing. The two standard deviation band indicates that these results are significant. During the baseline testing phase Participant Three knew one to two of the target verb probes. By the post-intervention phase Participant Three was able to identify all ten verb probes correctly.



**Figure 10.** *Number of target verb probes identified correctly by Participant Three.*

### Mean Length of Utterance

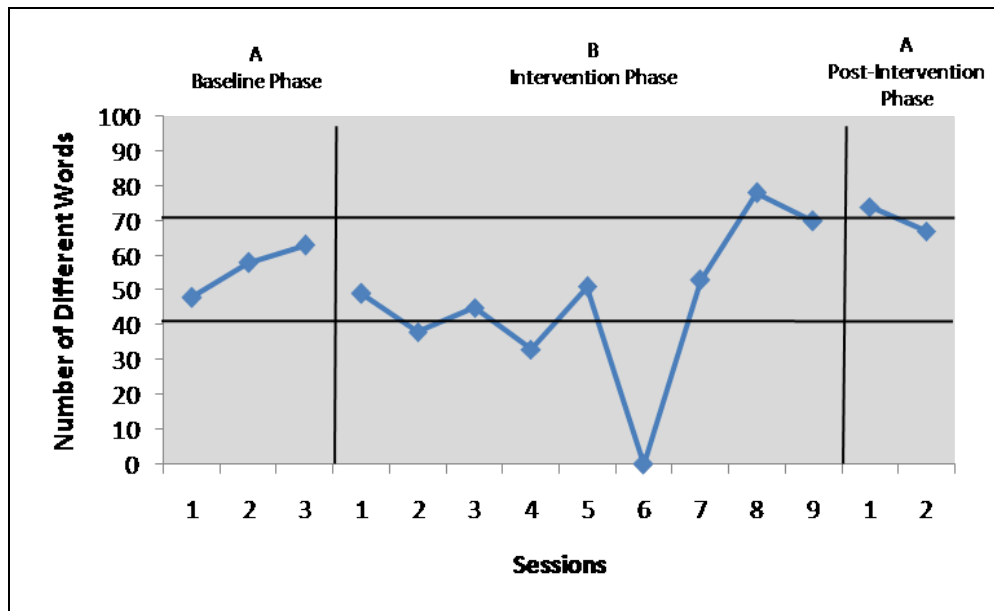
MLU in morphemes was measured during language sampling throughout the testing phases to identify whether increased success in identifying target verbs had generalised to MLU. Participant Three's results for MLU in morphemes are depicted in Figure 11. Despite being able to name all ten verb probes correctly by the final post-intervention phase, an increase in MLU in morphemes was not seen for Participant Three. The sharp decrease in use of different verbs depicted at session six on Figure 11 was due to behavioural issues. At session six Participant Three stated she could not hear out of her processor, even when not using the FM system. Batteries were in working order. Session six was abandoned shortly after administering the verb probes as Participant Three was becoming increasingly distressed at not being able to hear. No language sample was taken. The issue of the processor not working was successfully addressed and no problems occurred after session six. Apart from session six Participant Three maintained a stable MLU that did not significantly increase or decrease during the baseline, intervention and post-intervention phases.



**Figure 11.** *MLU in morphemes for Participant Three.*

### Different Words in Language Sampling

Similar to the Participant Two, Participant Three's correct identification of verb probes did not carry over into use of different words in a conversational language sample. A significant increase in the number of different words used was seen on one occasion in the intervention phase, however this was not maintained into the post-intervention phase.



**Figure 12.** *Use of different words by Participant Three.*

## Discussion

Newborn hearing screening programs are decreasing the age at which hearing loss is diagnosed (Geers, 2004). However, newborn hearing screening is not yet nationwide in New Zealand and some children are not being diagnosed with a hearing loss until four and a half years of age (National Screening Unit, nd). These children are at a high risk for language delays (Meyer et al., 1998; Nicholas & Geers, 2007). The purpose of this study was to investigate whether an intervention program designed at increasing vocabulary and ultimately language, could also be applied to children with hearing impairment who were diagnosed at differing ages. More specifically, the research questions sought were: 1) Would providing intervention targeting verbs lead to an increase in verb production in children with hearing impairment? 2) Would providing intervention targeting verbs lead to an increase in MLU in children with hearing impairment? and 3) Would providing intervention targeting verbs lead to an increase in the number of different words used in a conversational language sample in children with hearing impairment? It was hypothesised that children with hearing impairment would demonstrate improvement in expressive language as measured by mean length of utterance (MLU), the number of different words used in conversational language and expressive vocabulary after ten treatment sessions. Results were inconsistent with the original hypothesis. All participants' were able to increase their production of the target verbs. However, a significant increase in MLU in morphemes was not seen for any of the participants. Only Participant One had a significant increase in the number of different words in a conversational language sample. Implications of these results are discussed.

The intervention phase of the research study focused on the production of a selection of ten verbs not already present in each participant's vocabulary with the intention of increasing the use of each. Analysis of the data indicated that all three participants were successfully able to increase their use of the target verb probes and were consistently achieving 80-90% correct by the post-intervention phase. The principal investigator concluded that the intervention was effective for improving vocabulary in children with hearing impairment. This is consistent with the results of Gillon et al. (2007) who found that the same intervention approach was effective with a young child with typical hearing.

Contrary to expectation, the improvement in production of the targeted verbs did not result in a significant overall increase in MLU in morphemes, although a tendency for increased MLU was noted, particularly by Participant Two. Participant Two's MLU in morphemes increased significantly early in the intervention phase. However, at approximately session six Participant Two developed bilateral ear infections (otitis media). His mother reported that he was "more deafer than usual". This report was reinforced by medical diagnosis and Participant Two was placed on a course of antibiotic treatment. There is a wide body of evidence showing that middle ear dysfunction, specifically otitis media, can impact hearing thresholds and ultimately language development in young children (Winskel, 2006). Otitis media with effusion impedes normal sound transmission in the ear and results in a conductive hearing loss (Winskel, 2006). A child with a history of otitis media can vary often between periods of normal hearing and periods of hearing loss, which can affect language learning due to irregular stimulation of the central auditory nervous system (Winskel, 2006). For a child such as Participant Two with a permanent sensorineural hearing loss, the added conductive hearing loss resulting from an ear infection could have a significant effect to his hearing and ability to learn language (Winskel, 2006). The impact on his hearing and language can be seen by the way his MLU in morphemes decreased after session six. Prior to session six Participant Two showed a significant increase in the use of target verb probes in a conversational language sample. At session four of the intervention phase Participant Two had a MLU in morphemes of 3.43. At session six this had decreased to an MLU of 3.05. This result was also reinforced by the marking of the target verbs in conversational discourse using SALT analysis. Fluctuating hearing loss was also potentially a problem for Participant Three who reported at times that her speech processor was not working.

Fluctuating hearing could not entirely explain the results for Participant's One and Three however. Participant One in particular did not display any evidence of changes in hearing over the intervention and post-intervention sessions. One possibility for why an improvement in MLU was not noted for Participant One was that she was relatively unintelligible. When the principal investigator first met Participant One, speech intelligibility was a major issue. Several attempts at clarification were required in conversation, particularly if contextual cues were lacking. Intelligibility may have affected overall MLU count as when a word could not be deciphered it was marked as unintelligible and the utterance was disregarded.

In addition to MLU, the number of different words used by each participant in a conversational language sample was analysed to see whether any significant changes had occurred. Participant One had a significant increase in the number of different words used. At the beginning of the baseline phase Participant One was using 75 different words. By the post-intervention phase she was using 89 different words in a conversational language sample. Despite an increase in target verbs, Participant Two did not show a significant improvement in the number of different words. This result again may have been due to Participant Two obtaining bilateral ear infections during the intervention phase. Whilst Participant Three showed a significant increase in target verb probes, this did not result in an increase in number of different words used or MLU in a conversational language sample by the post-intervention phase.

### Clinical Implications

There are a number of clinical implications that have arisen from this study. The primary clinical implication is that intervention aimed at improving vocabulary is effective for children with hearing impairment. Language delay and vocabulary deficits can affect the child's ability to learn to read, influence comprehension in situations such as the school classroom and affect the child's self esteem and ability to socialise with others (Moeller, 2000). Previous research on deaf children who communicate orally have shown that these children have significant difficulty integrating within the school environment (Bat Chava et al., 2005). Participant Three had significantly delayed language and MLU. Her MLU in morphemes at the beginning of the baseline phase was 2.68, which equates to a normal hearing child of 31-34 months of age (McLeod & Bleile, 2003) As a result her reading age was six years of age. This was observed to be affecting her in the school environment. While Participant Three was in a chronologically age appropriate classroom, her ability to fully participate and understand classroom activities was questionable. Evidence of this was seen in Participant Three's conversational language samples. Discussions on what activity she had been participating in that morning in her classroom indicated her level of understanding. Participant Three was receiving help in all areas of her schooling apart from sport, with a large portion of her time being spent with teacher aides and a Teacher of the Deaf. In areas such as reading and maths, Participant Three would be sent to other classrooms where the children were chronologically younger and at her academic level. Whilst this was the best solution academically for her development it might not have been the

best solution for her social and emotional development. However, without placing Participant Three in a specialised school, her current school was catering to the best of their ability for her.

Although the intervention was highly successful in improving vocabulary, given limited resources, it would be beneficial to utilize an intervention approach that resulted in broad improvements (i.e. increased MLU for instance). The most well known habilitatory approach that is commonly considered for children with hearing impairment, particularly children fitted with cochlear implants and hearing aids, is Auditory Verbal Therapy (Estabrooks, 1994). This approach is most effective for children that are provided with amplification at a young age and its focus is primarily on speech and speech perception (Estabrooks, 1994). Emphasis is not placed on receptive language to the same extent. The hybrid intervention program used in this study is something that could be considered for language delays. However, the age at which a hybrid approach is to be implemented is worth consideration.

The hybrid intervention program used in this study may be more successful with younger children with hearing impairment closer to the critical period of language learning. Evidence that lends support to this suggestion is Page and Moran's (2007) study where the participant was aged 3;0 years. An increase was seen for this participant in use of target verbs in conversational language as well as an overall increase in MLU (Page & Moran, 2007). Although this participant was not hearing impaired they were still at an age where the critical period of language learning applies (Sharma et al., 2002). The age of this child differs somewhat considerably to the participants in this study, who were aged 4;5, 5;4 and 10;5 years. The research indicates that the hybrid language intervention program used in this study may be better suited to children younger in age. Participant Two was the youngest participant in this study and did appear to be making progress in MLU. His MLU was steadily increasing from the baseline phase. However, at approximately session six Participant Two started to get bilateral ear infections. This must have ultimately affected his hearing and his ability to accurately process language. It could be hypothesised from Participant Two's early results that this intervention program is suitable for children under the age of five. Further additional research could investigate this. The principal investigator also noted that whilst in the intervention phase, intervention was easier to plan for and administer to Participant Two than the other participants. This again could be the age difference as Participant Two was at a closer age to the



original age that this intervention was designed for. Participant Three was the oldest participant in this study and was 10;5 years. An increase in MLU in morphemes and the number of different words used in a language sample was not seen for Participant Three. Participant's One and Three may have benefitted from a more direct intervention approach. A more direct approach to intervention is clinician directed therapy where modelling and drill are employed (Fey, 1986).

### Limitations

There were several issues in this study that impacted on the success of the intervention program. One of the main issues for this study was participant recruitment. Children with cochlear implants who would have fitted the criteria for this study were not specifically located within Christchurch. This hindered the study as the funding and ethics granted were only suited to the immediate Christchurch area. Additionally, children who have a hearing impairment and language delay often will have other developmental difficulties and services that cater for these difficulties to attend. Parents need to manage audiology and habilitation appointments, they may have other children to care for or be trying to hold down employment at the same time. This may have contributed to the lack of participants being recruited for this study. Parents simply may not have had the time or resources to commit to ten weeks of intervention and testing.

Another factor which may have affected the results of the study was the fluctuating hearing performance of the participants. This was especially evident for Participant Two who experienced bilateral ear infections during the middle of the intervention phase. Evidence of this was Participant Two's performance for MLU in morphemes. MLU was increasing significantly until approximately session five, from where it started to decrease back to levels originally seen at the baseline phase. Participant Three also had fluctuating hearing as she often reported her speech processor was not working. Finally, participant motivation was believed to be a factor. Participant Three often appeared unwilling to participate in the intervention activities.

### Considerations for Future Research

The results of the current study provide an excellent foundation for future research in the area of language delay for children with hearing impairment. Specifically, a number of issues such as: 1) Type of approach, 2) Language sampling, and 3) Alternative modes of communication could be considered in future research projects.

#### *Type of Approach*

This research paper sought to establish whether the hybrid intervention program for improving vocabulary could be applied to children with hearing impairment. Results indicated that the program may be best suited to children of a younger age with hearing impairment. Future research could be to carry out the hybrid language intervention program on children more suited to the original design i.e. at ages 3;0 (Gillon et al., 2007). It would be of use for this program to be administered to children with hearing impairment at a younger age. This could include children who use hearing aids and children with cochlear implants.

The design of this hybrid intervention could be developed and improved for future research. The application of a home program in addition to the therapy may enable greater improvements and better generalisation. For example, this could be as simple as getting the parent and child to discuss what items they will ‘buy’ at the supermarket when grocery shopping (verb targeted ‘buy’). By having a home program the principal investigator would also be better able to direct or recommend on what the parents do at home to ensure that the results of the intervention remain valid.

#### *Language Sampling*

To accurately assess all areas of a child’s language, language sampling can be used to effectively assess language development and plan for future language intervention in everyday, typical situations (Hadley, 1998b). This study used conversational discourse language sampling to chart the participant’s MLU in morphemes and use of different word types. Conversational discourse is a conversation between two or more people where the topic is not scheduled and thought out

beforehand (Hadley, 1998b). It is the easiest form of discourse (Hadley, 1998b). The conversational partner needs only to plan as to what they will say next and monitor when conversational exchanges take place (Hadley, 1998b).

Other types of discourse available for language sampling are narrative and expository (Hadley, 1998b). These are more mentally taxing and require a higher level of language processing (Hadley, 1998b). Expository discourse is where the topic needs to be planned in advance as it involves factual or technical information on how to carry something out or give descriptions to arrive at a destination (Hadley, 1998b). With expository discourse the talker needs to consider how to relate back to the object or event, which pieces of the object or event are critical to the story, what background information the listener already has and adapt to this and what their viewpoint will be when discussing the object or event (Hadley, 1998b). Expository discourse will elicit more advanced language than conversational discourse. Language delays become more prominent with expository discourse sampling (Hadley, 1998b). Expository discourse may produce more mazing behaviour which is where the talker will use false starts, hesitate and repeat the message they are trying to get across (Hadley, 1998b). This can indicate deficits in utterance formation or word finding difficulties (Hadley, 1998b).

The use of conversational discourse sampling may have influenced the results obtained for each participant in relation to their mean length of utterance and number of different words used. During the testing phases language sampling was taken when discussing a game that the participant and principal investigator were playing, or conversing about something that had happened at school or on the weekend to the participant. A more suitable style of discourse may have been expository language sampling. This would have assessed a higher level of language processing and resulted in longer mean length of utterances. This style of sampling was trialled on Participant One in her last post-intervention phase session. For session one in the post-intervention phase Participant One achieved an MLU in morphemes of 3.37 using conversational discourse. For session two expository discourse was used. This resulted in an increase in MLU to 3.69. Expository language sampling was also carried out with Participant Two approximately two months after the conclusion of the post-intervention phase. With the expository method Participant Two achieved an MLU in morphemes of 1.96. This is less than the last conversational language sample in the post-intervention phase where

Participant Two achieved an MLU in morphemes of 2.98. The reason why an increase in MLU was not seen with Participant Two with expository language sampling could be because he is too young for this sampling method (Participant One was 5;4 years, Participant Two was 4;5 years). Or, the expository method is highlighting a more advanced language deficit (Hadley, 1998b).

While using expository discourse resulted in an increase in MLU for Participant One, there is one main advantage of using conversational discourse that expository discourse does not have. Conversational discourse has norms available for each age in preschool years that can be used to chart where a child is in terms of language development (McLeod & Bleile, 2003). There is no normative data available for appropriate MLU's at given ages for expository language sampling (Hadley, 1998b).

Another factor related to language sampling as an outcome measure is related to the size of the sample. The literature states that a sample size for language sampling should never be less than 50 utterances (Eisenberg et al., 2001). This is because it is felt a smaller sample size is not an accurate reflection of the child's true expressive ability (Eisenberg et al., 2001). Obtaining an adequate sample size was a difficulty with Participant Three. This was because Participant Three's language was so restricted. Often the language samples, especially ones early in the baseline phases were based on approximately 30 utterances instead of at least 50. Participant Three's results must be interpreted with this in mind. Language sampling can be subject to the participant's behaviour which can be variable on an hour to hour basis (Nicholas & Geers, 2008). A parental report measure can help to account for this variability as it is made from a large number of different situations and does not rely on the child's participation at a given time (Nicholas & Geers, 2008). The smaller language sample size adds to the difficulty that the principal investigator was not able to obtain a completed MacArthur Bates Communication Inventory from Participant Three's educational carers. Participant Three was seen in a school environment as English was not used in the home. For reasons beyond the control of the investigator people that interacted with Participant Three on a day-to-day basis did not have the time to complete the inventory. This makes it difficult to accurately quantify her language delay. When added to the questionable validity of a smaller sample size for language sampling, the results should be interpreted with caution.

### *Alternative Modes of Communication*

Another population that this intervention could be investigated with would be children who are deaf and use sign language as their primary method of communication. Children who use sign language are at a very real risk of language and reading delays. Data collected in the United States of America indicates that the typical deaf student will graduate from high school with levels of language and overall academic achievement equivalent to that of a 4<sup>th</sup> grade student with normal hearing (Yoshinaga-Itano et al., 1998).

### *Sound Measurements*

Accurate and reliable sound level measurements should be made of the areas that the intervention is being administered. This is of importance as children with hearing impairment need an even larger signal to noise ratio compared to normal hearing children to accurately perceive auditory information (Ruscetta, Arjmand & Pratt, 2005). If the speech signal is not below this signal to noise ratio then the level of benefit the participant with hearing aids or a cochlear implant gains from the intervention may not be maximised.

### *Stimulus Use*

Another item that may need to be considered is the use of the target verb pictures. Black and white Boardmaker pictures were used for the target verb pictures. Participant Two's mother stated during one session in the intervention phase that her child responded better to photos than black and white drawings. If this intervention program was administered to younger children it may be of benefit for the target verb pictures to be photographs in colour rather than black and white Boardmaker drawings. Children may more readily identify with these pictures and better associate them with the activities and toys they use in the intervention to represent these verbs. It may also assist in generalisation as the photos would be real-world items.

### *Control*

The control of adjectives was not used in this study. This is something that should definitely be applied to future applications of this hybrid intervention program to validate the results.

### *Participants*

Additionally, the current research could have been improved with a larger participant pool. This would have enabled judgements of trends and whether this intervention could be generalised and made into a valid intervention program for children with hearing impairment and language delay.

## Conclusions

The aim of this study was to investigate whether an intervention program aimed at increasing expressive vocabulary for children with hearing impairment exhibiting a language delay would increase their overall expressive and receptive language. All three participants' increased their production of the target verbs. Contrary to the hypothesis, an increase in MLU in morphemes was not seen for any of the participants. Only Participant One had an increase in the number of different words used in a conversational language sample.

The participants in this study were aged 10;5, 5;4 and 4;5 years and were older than that which the hybrid program was originally designed for. The results post-intervention showed no overall increase in the three participants' expressive and receptive language. Previous research with the intervention program on a younger child has shown success at increasing MLU and vocabulary (Page & Moran, 2007). Clinical implications of this paper are that the hybrid intervention program may be more suitable to children of younger ages. Older children with hearing impairment such as Participant Three may benefit more from a more directive approach and a longer intervention period. Additionally, when working with any child with hearing impairment their fluctuating hearing levels must be taken into account when interpreting the results. Fluctuating hearing levels may not be simply due to middle ear dysfunction; hearing aid or cochlear implant malfunction can also alter hearing. When working with this population familiarity with the amplification device and how to effectively trouble shoot the device is essential.

For children with a significant hearing impairment, providing them with amplification may not be sufficient to prevent language delays and other early intervention may need to be provided (Yoshinaga-Itano et al., 1998). The hybrid intervention program investigated in this paper may be one way that this could be accomplished as it has potential to be used with early identified hearing impaired children. It could also supplement habilitation programs used for children with cochlear implants. Further future investigation is warranted to see whether this intervention program may be better suited to children at a younger age with hearing impairment.

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## **Appendices**

### **Appendix I**

New Zealand Human Ethics Committee approval letter, information sheet for parents and consent form for participants.



Ref: HEC 2008/31

25 August 2008

Ms Katie Morgan  
Department of Communication Disorders  
UNIVERSITY OF CANTERBURY

Dear Katie

Thank you for providing a copy of the New Zealand Health & Disabilities Ethics Committee approval for your research proposal “Vocabulary intervention aimed at improving expressive language for children with hearing impairment”. I am pleased to advise that final approval has now been given by the University’s Human Ethics Committee.

Best wishes for your project.

Yours sincerely

Dr Michael Grimshaw  
*Chair, Human Ethics Committee*



## INFORMATION SHEET

Your child is invited to take part in the research project titled “***Vocabulary Intervention for Children with Hearing Impairment***”. Please take the time to read this information sheet thoroughly and consider whether you would like to participate. This study is being conducted by the following researchers:

Principal Investigator:

**Miss Katie Morgan**, Bachelor of Speech-Language Therapy, Master of Audiology candidate, University of Canterbury.

Supervisors:

**Dr Catherine Moran**, Head of Department Communication Disorders, University of Canterbury.

**Dr Valerie Looi**, Lecturer, Department of Communication Disorders, University of Canterbury.

### About the Study

Children with hearing impairment can present with language and communication delays due to the lack of auditory input from an early age. One aspect of language that has been thought to be affected in children with hearing impairment, even those with cochlear implants is word use (vocabulary) and sentence length. Vocabulary development is particularly important as it contributes to overall language and literacy development. This study aims to improve vocabulary development in children with hearing impairment. In addition, overall growth in language will be evaluated.

Approximately 6 children aged 3 to 4 years of age with hearing impairment are required for this study. All assessments and the intervention programme for the study will be administered by a qualified speech-language therapist who is also in her senior year of the Master of Audiology programme. To participate in the study your child must speak New Zealand English as their first language and have no known neurological disorders outside of hearing loss.

This study involves the following assessment and rehabilitation commitments. The assessments will be carried out either at Van Asch Deaf Education Centre (Truro Street, Sumner, Christchurch) or the Department of Communication Disorders at the University of Canterbury.

**PART I: ASSESSMENT STAGE:** Total time required = 3 hours (60 minutes per day over three days)

Language Assessments: Total time required = 2 hours

Peabody Picture Vocabulary Test - : This measures understanding of vocabulary. Your child will hear a word and will point to the picture that represents that word (Time – 45 minutes).

Clinical Evaluation of Language Fundamentals-Preschool: This evaluates how well your child understands and produces language. The test involves simple tasks such as pointing to a picture or describing a picture (Time – 45 minutes).

MacArthur-Bates Communication Developmental Inventory: This is a parent questionnaire that gathers information about what words your child is using (Time – 20 minutes).

Language Sample: This involves engaging your child in a play situation and recording their speech (Time – 10 minutes).

2. Hearing Assessments: Total time required = 45 minutes

Play Audiometry: This is a hearing assessment to see what your child is hearing through their hearing aids. Your child listens to sounds through a speaker and places a peg in a pegboard when they hear the sound (Time – 30 minutes).

Tympanometry: This is an assessment looking at how your child's eardrums are moving. It involves placing a tip into your child's ear canal and a machine administering some pressured air to gain relevant measurements (Time – 15 minutes).

PART II: PRE-THERAPY MEASURES STAGE: Total time required = 60 minutes (20 minutes per day over three weeks)

In order to determine if the treatment works, some samples of your child's language will be recorded. The therapist will show some toys to your child and encourage your child to talk about the toys whilst playing with them (Time – 20 minutes).

PART III: INTERVENTION STAGE: Total time required = 10 hours (1 hour per day, twice a week, over 5 weeks)

The therapy sessions will begin with five minutes of teaching where target words are shown on picture cards. Your child will be asked to produce the word, and if they cannot do so the therapist would then demonstrate. Next, the therapist and your child will read a story together that focuses on the target words.

Finally, the therapist and your child will engage in some focused play where toys representing the target words are provided. Your child is encouraged to produce the target words but it is not a requirement.

For the therapy you, as the parent will not be required to participate, however you can stay in the room with your child.

**PART III: RE-ASSESSMENT STAGE:** Total time required = 2 hours (2 hours in one session in one week)

Re-assessment involves repeating the language assessments such as the Peabody Picture Vocabulary Test, the Clinical Evaluation of Language Fundamentals-Preschool, and the MacArthur-Bates Communication Developmental Inventory. Another language sample would also be taken, which would require your child to engage in a play activity for 20 minutes, where what they say is recorded.

### Benefits of the Study

This study could have direct benefits to your child. It has been shown that an intensive programme aimed at development of vocabulary results in improved vocabulary and sentence structure for children with cleft palate. It is hoped that your child will show improvements in this area. If the intervention is not successful, it will provide the researchers with information that will better inform future language habilitation programmes and allow them to modify the current intervention program for future use.

### Safety and Potential Risks

Your child's hearing aid settings will not be altered by participating in this project. The risks of this project are no different to participation in normal habilitation sessions and audiological assessments.

In the unlikely event of a physical injury as a result of your participation in this study, you may be covered by ACC under the Injury Prevention, Rehabilitation and Compensation Act. ACC cover is not automatic and your case will need to be assessed by ACC according to the provisions of the 2002 Injury Prevention Rehabilitation and Compensation Act. If your claim is accepted by ACC, you still might not get any compensation. This depends on a number of factors such as whether you are an earner or non-earner. ACC usually provides only partial reimbursement of costs and expenses and there may be no lump sum compensation payable. There is no cover for mental injury unless it is a result of physical injury. If you have ACC cover, generally this will affect your right to sue the investigators.

If you have any questions about ACC, contact your nearest ACC office or the investigator.

### Participation

You and your child's participation is entirely voluntary (your choice). You do not have to take part in this study, and if you choose not to take part your child will continue to receive the usual treatment/care.

You are free to withdraw from this study at any time, and your withdrawal will not affect your child's current or future health care.

If you have any queries or concerns regarding your rights as a participant in this study you may wish to contact a Health and Disability Advocate, telephone Christchurch 03 377 3501 or outside Christchurch 0800 377 766.

You may have a friend, family or whanau support to help you understand the risks and/or benefits of this study and any other explanation you may require.

What will happen at the end of the study?

Following your and your child's participation in the study you will receive a verbal explanation of your child's results. You will be sent a written report of the results at the completion of the research project.

You will be asked if you would like to take home a copy of your child's speech and language recordings. If you would, these will be copied to CD and posted to you within one month of your child's completion of the study.

#### Privacy and Confidentiality

You and your child's privacy and confidentiality will be maintained at all times. Data collected from the study will be stored for 10 years after the youngest participant in the study has turned 16 years of age, after which data will be destroyed. All information will be kept in a secure area at the Department of Communication Disorders, University of Canterbury. Only the researchers involved in the project will have access to this information. The results of this project will be published. However, no material which could personally identify you or your child will be used in any reports on this study. Feedback on individual assessment results will be provided at the time of testing and a summary of your child's results will be sent to you at the completion of the research project. Please note that the researchers will also need to access information regarding the type and severity of your child's hearing impairment and details of their hearing aid from their medical and audiological history. This information is required to understand the influence of your child's hearing impairment upon speech and language function. Again, this information will be kept confidential.

#### Ethical Approval

This study has received ethical approval from the Upper South B Ethics Committee and the University of Canterbury Ethics Committee.

Please do not hesitate to contact Miss Katie Morgan if you have any questions regarding your participation in this project (see contact details below). If you have any complaints or concerns, you can also contact the supervisor of this study, Dr Catherine Moran.

**Miss Katie Morgan**  
**Master's of Audiology Student**  
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## **Vocabulary Intervention Aimed at Improving Expressive Language for Children with Hearing Impairment**

### *CONSENT TO PARTICIPATE*

Lay Title                      Vocabulary Intervention for Children with Hearing Impairment.

Principal Investigator Katie Morgan

Participant's Name \_\_\_\_\_

I consent to (insert participant's name) participating in this study.

I have read and I understand the information sheet dated \_\_\_\_\_ for people taking part in the study designed to increase vocabulary for children with a language delay who have a hearing impairment. I have had the opportunity to discuss this study. I am satisfied with the answers I have been given.

I understand that taking part in this study is voluntary and that myself and my child may withdraw from the study at any time if he/she wishes. This will not affect my child's continuing health care.

I understand that my child's participation in this study is confidential and that no material which could identify my child will be used in any reports on this study.

I know whom to contact if my child has any side effects to the study or if anything occurs which I think he/she would consider a reason to withdraw from the study.

This study has been given ethical approval by the University of Canterbury Ethics Committee and the Health and Disabilities Ethics Committee. This means that the Committee may check at any time that the study is following appropriate ethical procedures.

I give consent for medical records of my child to be released for the purpose of the study on the understanding that all information will be kept confidential.

I/my child would like a copy of the results of the study.

**YES/NO**

Signed: \_\_\_\_\_

Date \_\_\_\_\_

Printed Name: \_\_\_\_\_

Relationship to Participant: \_\_\_\_\_

Address for results : \_\_\_\_\_

**STATEMENT BY PRINCIPAL INVESTIGATOR**

I Katie Morgan declare that this study is in the potential health interest of the group of patients of which (name of participant) is a member and that participation in this study is not adverse to (name of participant)'s interests.

Signed: \_\_\_\_\_ Date \_\_\_\_\_  
Principal Investigator

**STATEMENT BY INDEPENDENT CLINICIAN**

I confirm that participation in the study is not adverse to \_\_\_\_\_ (participant)'s interests.

Signed: \_\_\_\_\_ Date \_\_\_\_\_  
Clinician

Printed Name : \_\_\_\_\_

## Appendix II

Target words used in intervention phase and procedures used for intervention.



Target Word List

**Participant 1**

Target Word
Broke
Carry
Forget
Hold
Point
Pour
Skate
Throw
Tie
Wrap

**Participant 2**

Target Word
Blow
Buy
Cry
Drink
Draw
Fly
Listen
Pour
Shout
Swing

**Participant 3**

<b>Target Word</b>
Climb
Close
Dress
Leak
Measure
Pour
Reach
Ride
Send
Shout

### Procedures for hybrid intervention

(Adapted from Gillon, Moran & Page, 2007)

#### 1. Structured teaching:

- Present pictures representing target words. Ask the child ‘What is happening in the picture?’ The child is not required to produce the target. If the child does not produce the target spontaneously, then model the target for the child.

#### 2. Structured teaching in context:

- Present storybooks containing words and pictures representing the target words. Model and discuss targets verbally. For example, ‘Fell ... look, the cat fell off the roof’. The child is not required to produce the target words, but is required to attend to the storybooks.

#### 3. Focused stimulation:

- Toys representing the target words are arranged in the clinic.
- The target words are modelled by the clinician during play.
- The clinician provides opportunities for the child to produce the targets by engaging them in play with the appropriate toys.
- The clinician follows the child’s lead and models the targets for them.
- For example, ‘The girl is climbing, climbing, climbing, climbing (pause to tempt the child to produce the target)’.

